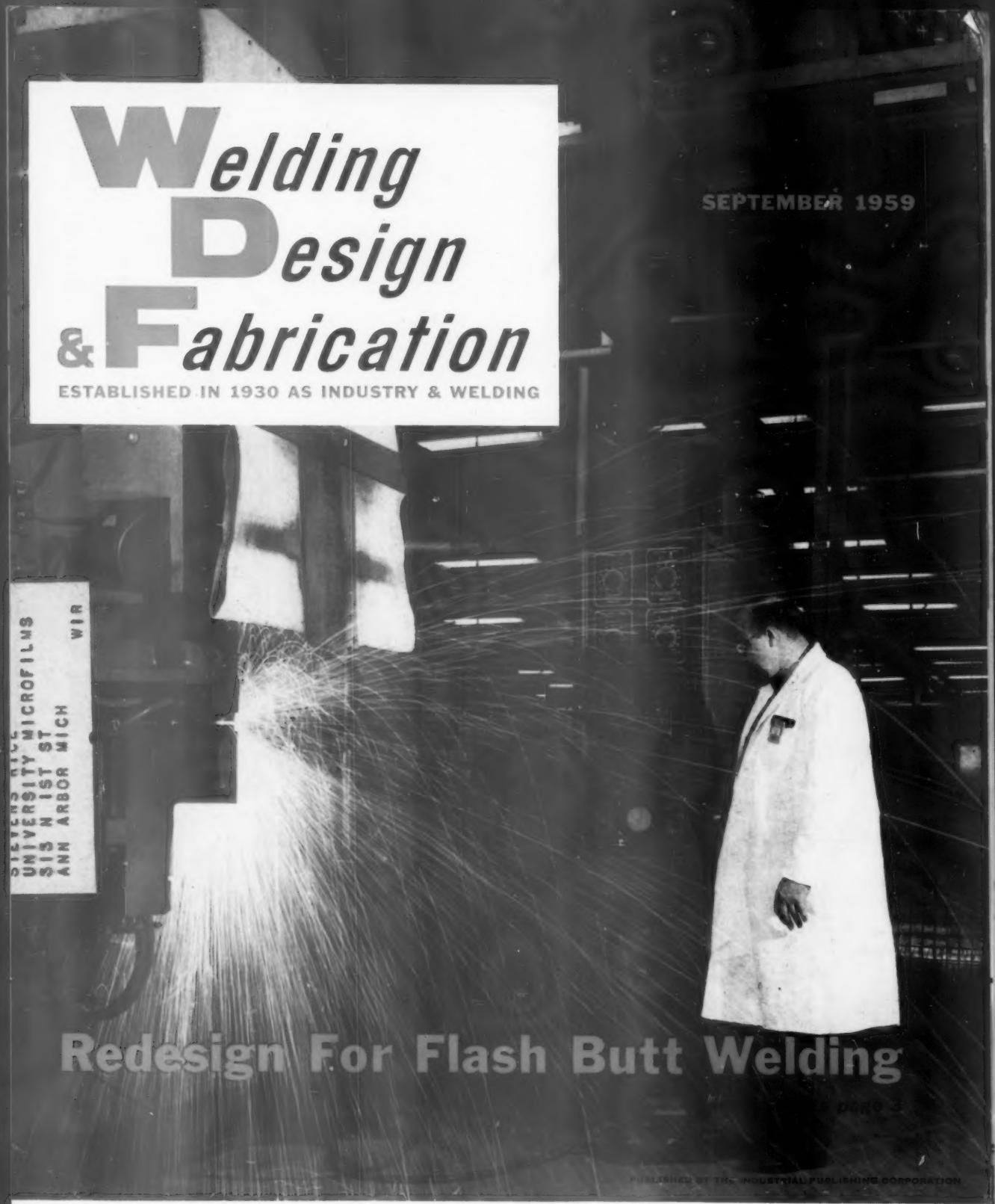

Welding Design & Fabrication

ESTABLISHED IN 1930 AS INDUSTRY & WELDING

SEPTEMBER 1959

STEVENS INST
UNIVERSITY MICROFILMS
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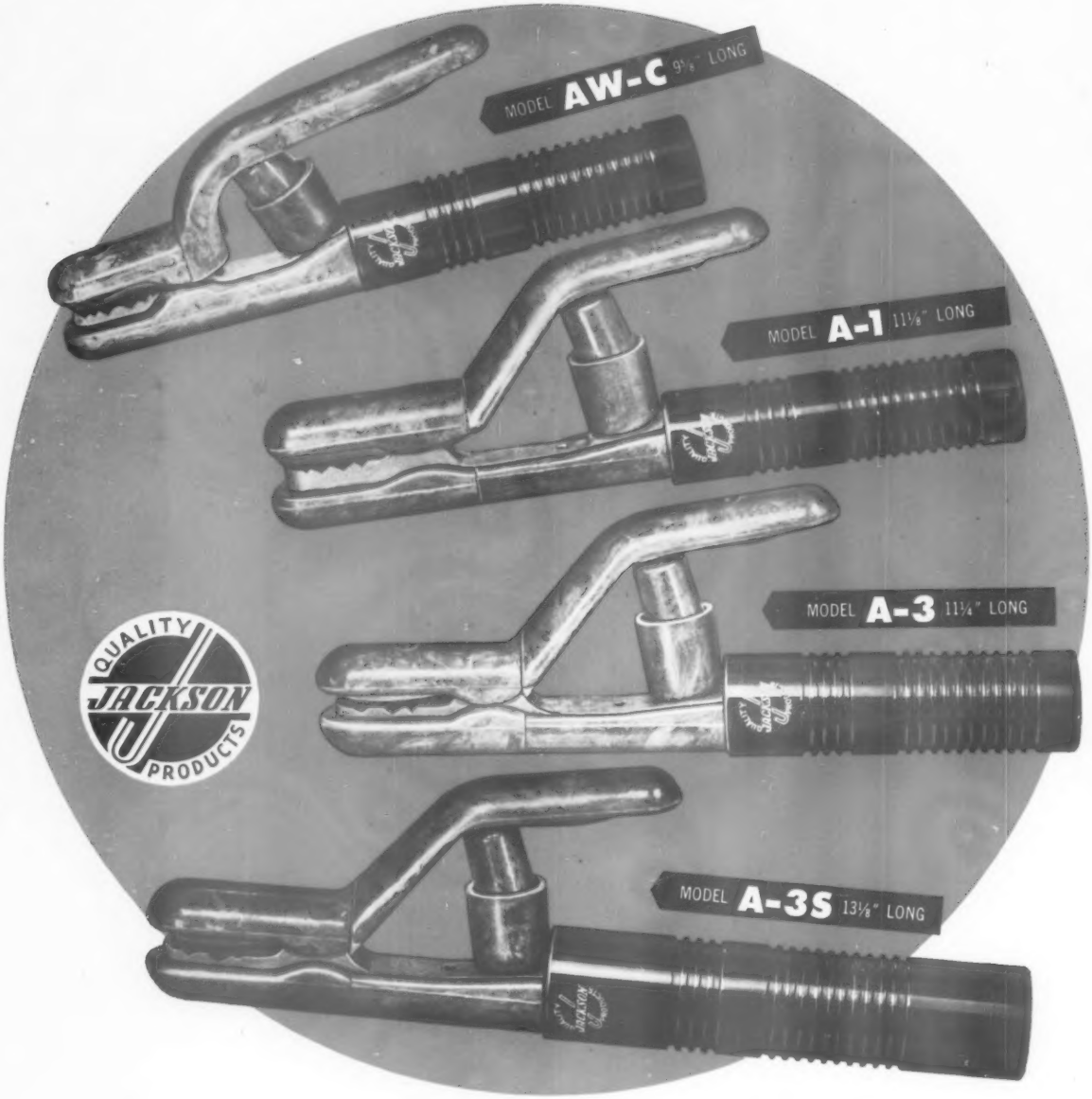
Redesign For Flash Butt Welding

Page 3

PUBLISHED BY THE INDUSTRIAL PUBLISHING CORPORATION

The magazine of welding management, production, and engineering



Jackson Duty-Cycle Rated Holders

Tongs of heat treated 98% copper alloy with high-impact, heat resistant glass fiber insulators permit highest duty cycles with a wide margin of safety.

For top production, select the holder best suited to the job at hand. The table at the right rates these holders by duty cycle, that is the percentage of arc time in any ten-minute period of work, depending on rod size, amperage and cable size.

Holder Class	Model	Electrode	Amps & Cable	Duty Cycle
Small	AW-C	7/32"	250-1 300-1/0	50%
Medium	A-1	1/4"	300-1/0 350-2/0	50%
Large	A-3	3/8"	375-2/0 450-3/0	65%
Heavy-Duty	A-3S	3/8"	500-4/0	80%

Sold Everywhere by Better Welding Supply Distributors and Dealers

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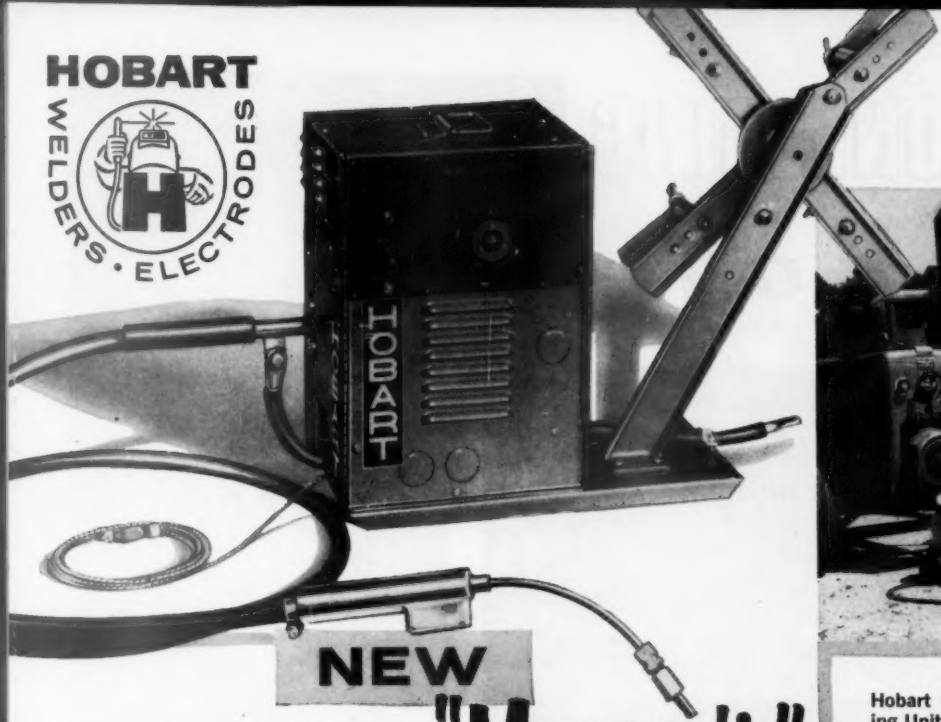
WELDERS • ELECTRODES



Hobart Manumatic Semi-Automatic Welding Unit being used to hardsurface Gradal Bucket with Hobart tubular wire—open arc.

NEW HOBART "Manumatic"

. . . FEEDS WIRE AUTOMATICALLY

FOR HARDSURFACING, BUILDUP AND MILD STEEL WELDING

Now you can profitably use semi-automatic welding for greater production at lower cost. This inexpensive Hobart "Manumatic" unit can be teamed with an AC or DC welder of sufficient capacity to handle Hobart's new "Manumatic." Brings higher weld deposition rates and higher duty cycle.

EASY TO USE—The "Manumatic" is compact and easy to use in what normally would be awkward and difficult places. Simplified controls speed operation. A rheostat controls wire speed. A high-low inch switch and a forward-reverse inch switch conserve welding wire and simplify new coil threading. To start the arc, merely touch the feed wire to the work.

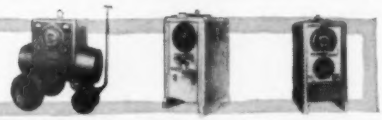
CUT COSTS BY INCREASING WELD DEPOSIT—The "Manumatic" soon pays for itself. Deposits welding wire at least three times faster than the manual stick electrode method. Feed rolls and current tips are available for 5/64" and 3/32" solid hard wire and 3/32", 7/64" tubular (fabricated) wire.

Write today for complete details, without obligation, to: HOBART BROTHERS CO., BOX HW-99, Troy, Ohio, Phone FE 2-1223. "Manufacturers of the world's most complete line of arc welding equipment."

- **USE EITHER OPEN ARC SUBMERGED ARC**
  feeds solid or tubular wires with proper equipment and accessories.
- **EASILY CONNECTS TO YOUR AC OR DC WELDER**
- **ATTAINS HIGH DEPOSITION RATES**
  wire speed up to 260 inches per minute. (Up to 460 ipm with optional gear box.)
- **LOW COST**
  permits both large and small shops to use the "Manumatic" continuously or part time.

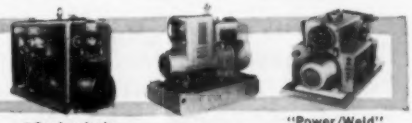
CHOOSE FROM THE WORLD'S MOST COMPLETE LINE OF ARC WELDERS . . . CHOOSE A HOBART

FOR INSIDE WORK



Standard Electric Drive 200 to 600 amps. DC — Transformers 300 to 500 amps. — AC/DC Inert Gas Combination

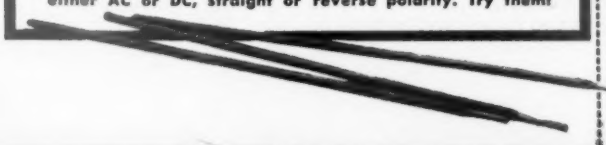
FOR OUTSIDE WORK



"Contractor's Special" 250 Amps. DC — "Husky Boy" 250 Amp. DC — "Power/Weld" 200 Amp. DC Welder and AC Power Unit

FASTER . . . BETTER
New IRON POWDER
ELECTRODES

by Hobart are easy to use and control. Speeds weld deposition rates and results in a finely rippled, high quality bead. Available for all types of general purpose use either AC or DC, straight or reverse polarity. Try them!



HOBART BROTHERS COMPANY, BOX HW-99, TROY, OHIO
Please send me complete details on the items I've checked:

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- ☐ Transformers ☐ AC/DC Inert Gas Combination
- ☐ "Contractor's Special" ☐ "Husky Boy"
- ☐ "Power/Weld" ☐ Hobart iron powder electrodes
- ☐ Electric Drive Welders ☐ New Hobart All Machine catalog

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MAGNETIC WELDING CLAMPS

Quality POSITIONERS by **Aronson MACHINE COMPANY**
ARCADE, NEW YORK

For More Information Circle No. 13 on Reader Service Card.

reader's guide to *for September, 1959*

COVER: Thompson Ramo Wooldridge, Inc., has used every process to weld every superalloy or low alloy steel for every jet engine there is. Flash butt welding has proved to be the answer to welding problems. Using a 250 KVA welder with special dies saves 65 percent over manual arc welding. This is possible because one operator produces six times as many pieces and because rejects are down to half of one percent compared to a previous 12 percent.

FEATURES

43 AIRCRAFT INDUSTRY FORECASTS MORE AUTOMATIC WELDING AND BRAZING
This is the consensus of a 10-year forecast of trends and requirements just released by the Aerospace Industries Association.

44 RESISTANCE WELDING TINY, DISSIMILAR METAL PARTS
A special 5,000 square foot dust-free room and specialized spot and stored energy welding techniques simplify fabrication of intricate tube mounts.

46 WILL BRAZED MOLYBDENUM REPLACE "SUPERALLOYS" IN JET ENGINE PARTS?
Successful application of molybdenum to many jet engine components will hinge on its ability to be brazed for high temperature service.

49 R.W.A.A. PROPOSES NEW ELECTRODE NUMBERING SYSTEM
A proposed numbering system for resistance welding electrodes simplifies an old, confusing system of taper sizes and adds two new sizes.

50 WELDING PLATENS CAN STOP DISTORTION
Heavy, waffle-like tables are a necessity wherever there is welding, bending, straightening, heating or assembling.

53 STRESS RELIEVING IS THE KEY TO WELDING ALLOY PIPING
Combustion Engineering stress relieves to get quality welds in chrome-moly and stainless piping for a steam power generator.

54 A DESIGN APPROACH TO QUALITY CONTROL OF STRUCTURAL WELDING
Discussed are the factors which affect the quality control of structural welding: drawings, materials, electrodes and welding, and inspection and supervision.

56 FLASH BUTT WELDING CUTS JET RING COSTS 65%
A single operator now turns out 600 percent more jet engine rings; rejects have been cut from 12 percent to one-half of one percent.

60 KNOW YOUR FILLER METALS
A discussion of the nonferrous filler metals, the important surfacing alloys and tungsten electrodes: where, how and why they are used.

62 THE STRENGTH OF ARC WELDED JOINTS
Here are the principles involved in calculating nominal stresses in welded joints and determining their strength.

66 BRUSH PLATING SPEEDS ALUMINUM SOLDERING
Brush plating covers aluminum with an easy-to-solder nickel surface.

71 CLOSED-CIRCUIT TELEVISION GUIDES AUTOMATIC WELDING HEAD
U.S. Steel's National Tube Division uses television to get quality welds on inside diameter of 40-foot long pipe.

DEPARTMENTS

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New Bausch & Lomb Line of

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ILLUSTRATED: S-84P Coverall, with comfort-fit contour, has exclusive, removable face pad of soft sponge rubber that snaps in place. Injection-molded thermo-plastic, in cool-green, high-luster finish.

New features, new values, NO increase in price!

It's a completely improved line, giving welders added safety, comfort and visibility. New super-tough thermo-plastic, injection molded, is better looking, easier to keep clean. Arc-Ban lenses, available in 10 different shades, give complete protection against injurious radiations while allowing efficient, comfortable vision. New louvered side shield baffles provide indirect ventilation while giving complete protection against sparks, scale, light radiations, side flashes. Write for folder A-1684 for complete details: Bausch & Lomb Optical Co., 91045 Smith St., Rochester 2, New York.

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Welding Design & Fabrication

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WELDING DESIGN & FABRICATION
was established in 1930 *as*
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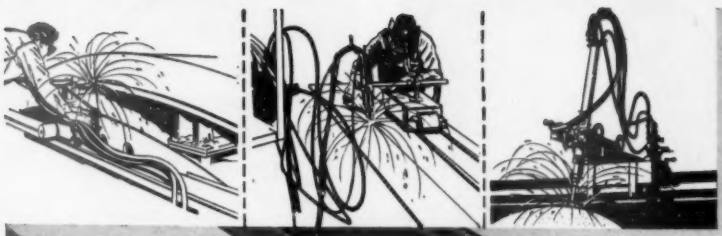

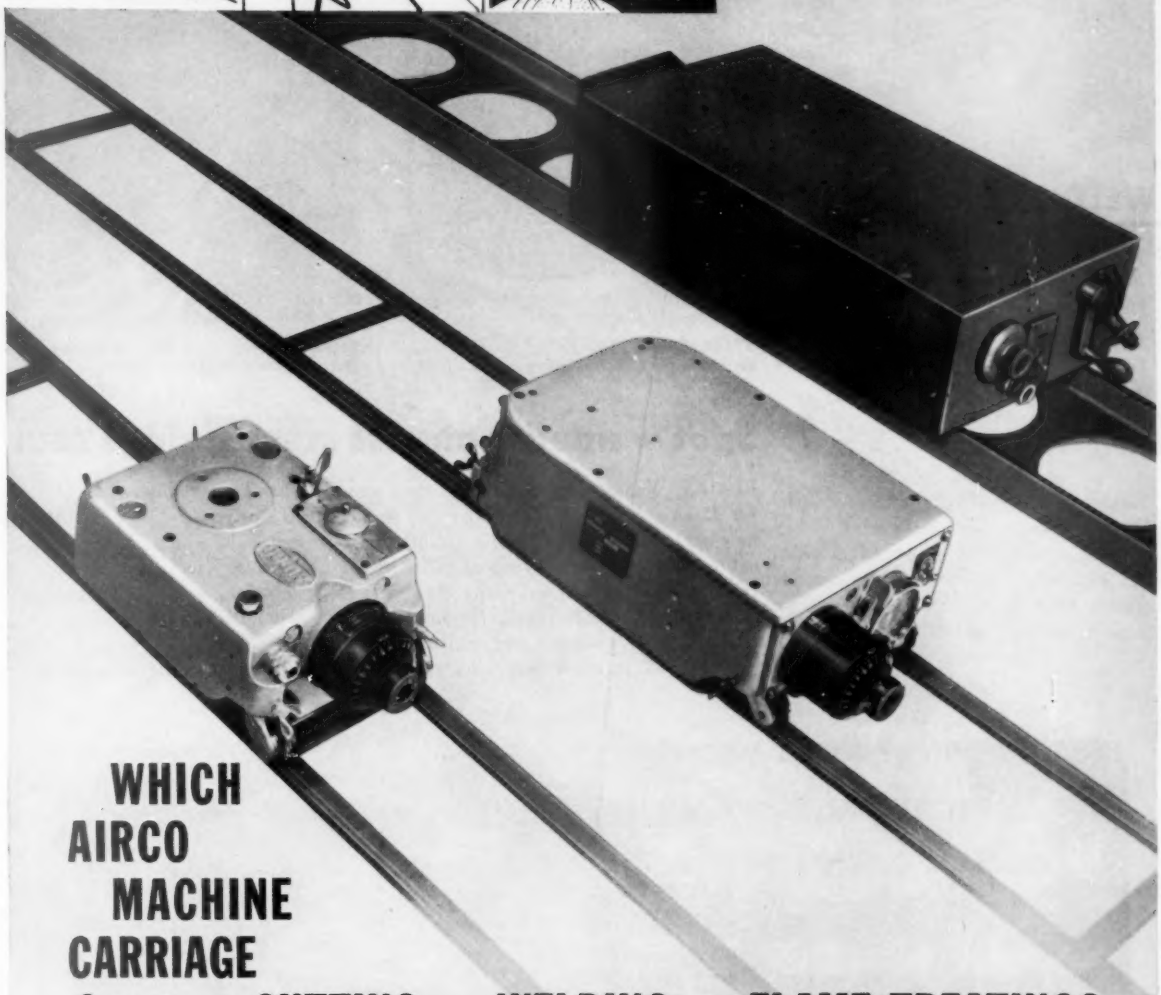

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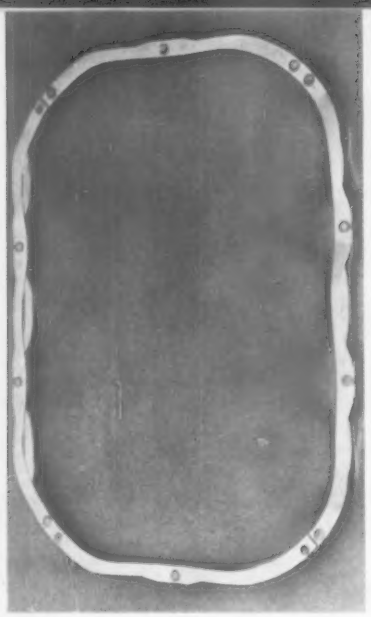
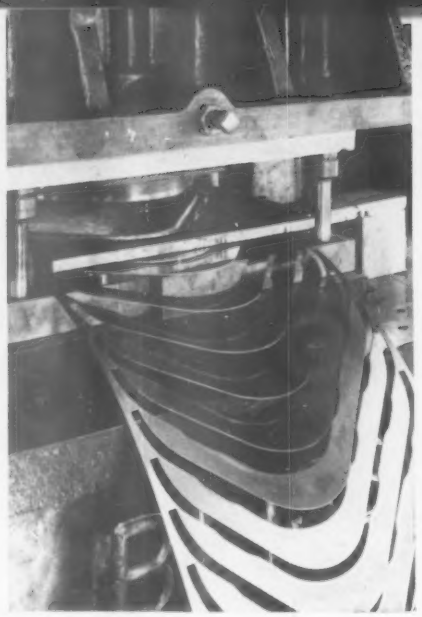
WELDING AT WORK

to do the job better and cheaper



STAINLESS window spring is compressed 1/4-inch when installed in jet airliner.



SEGMENTS are stamped and formed from .052-inch stainless 14 1/2-inch wide.

Spot welded stainless steel springs seal

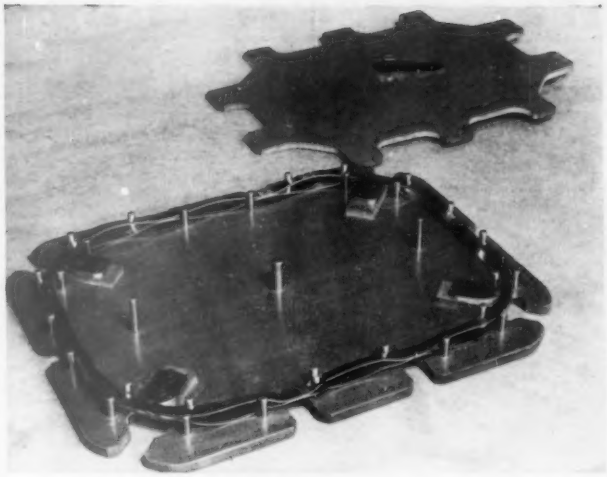
RENTON, WASHINGTON: Stainless steel window springs are fabricated here for Boeing 707 jet airliners by the Renton Coil Spring Co. The springs help seal more than 100 plane windows and prevent leaks which could lower cabin pressure when flying at altitudes of over 31,000 feet at 605 mph. Because the spring is not easily accessible for inspection, it must be capable of standing up under compression without attention under wide and rapid changes in temperature and environment.

Type 301 stainless was selected because of its high strength-to-weight

Tapered columns formed by welding split beams

FINNEYTOWN, OHIO: Fourteen bays of this 75-foot high school building in Hamilton County are encased in 15 rigid arc welded frames 14-feet 3-inches high at the eaves and 15-feet high at the center. The seven-bay clerestory rises another 7-feet above the lower portion.

Tapered columns and rafter end sections were fabricated at the plants of L. Schreiber & Sons Company, Cincinnati, and shop welded together at the knuckle joints before shipment to the site. Columns were formed by splitting 21 inch WF beams diagonally along the web, reversing one half and then welding the webs by the submerged arc process, using Lincoln Electric ML-2 equipment. This gave a tapered section about 10 inches wide at the base and 32 inches wide at the top. Rafter end sections are also composite elements, made by arc welding a Tee to half of a diagonally split 21-inch beam. This technique provided for maximum material use and minimum scrap.



FOUR SEGMENTS that make up a spring are assembled in a jig and joined by spot welding.

25 KVA SPOT WELDER operates on 440 volts and uses .3 second contact time with .400-inch contact diameter.

jet airliner windows at 31,000 feet and 605 mph

ratio and excellent corrosion resistance. Installed in a full hard condition, it has a minimum tensile strength of 185,000 psi. The seal is compressed almost ¼-inch when installed and exerts a strong pressure on each face of the double windows.

The seal, which is essentially a series of 10 double elliptical springs, is 13 11/16- by 10¼-inch and weighs about seven ounces.

The segments are stamped and formed from stainless strip 14½-inches wide and .052-inch thick (plus or minus .002-inch) furnished by the Stainless and Strip Division, Jones & Laughlin Steel Corp. Four segments that make up a spring are assembled in a jig and spot welded. The welder is a 25 KVA unit operating on 440 volts, using .3 second contact time with .400-inch contact diameter.

Storage tank fabricator uses X-ray examination for three sound reasons

CHESTER, PA.: Fisher Tank Company uses Balteau X-ray equipment to check weld quality and get visible records. X-ray inspection actually has three functions at Fisher:

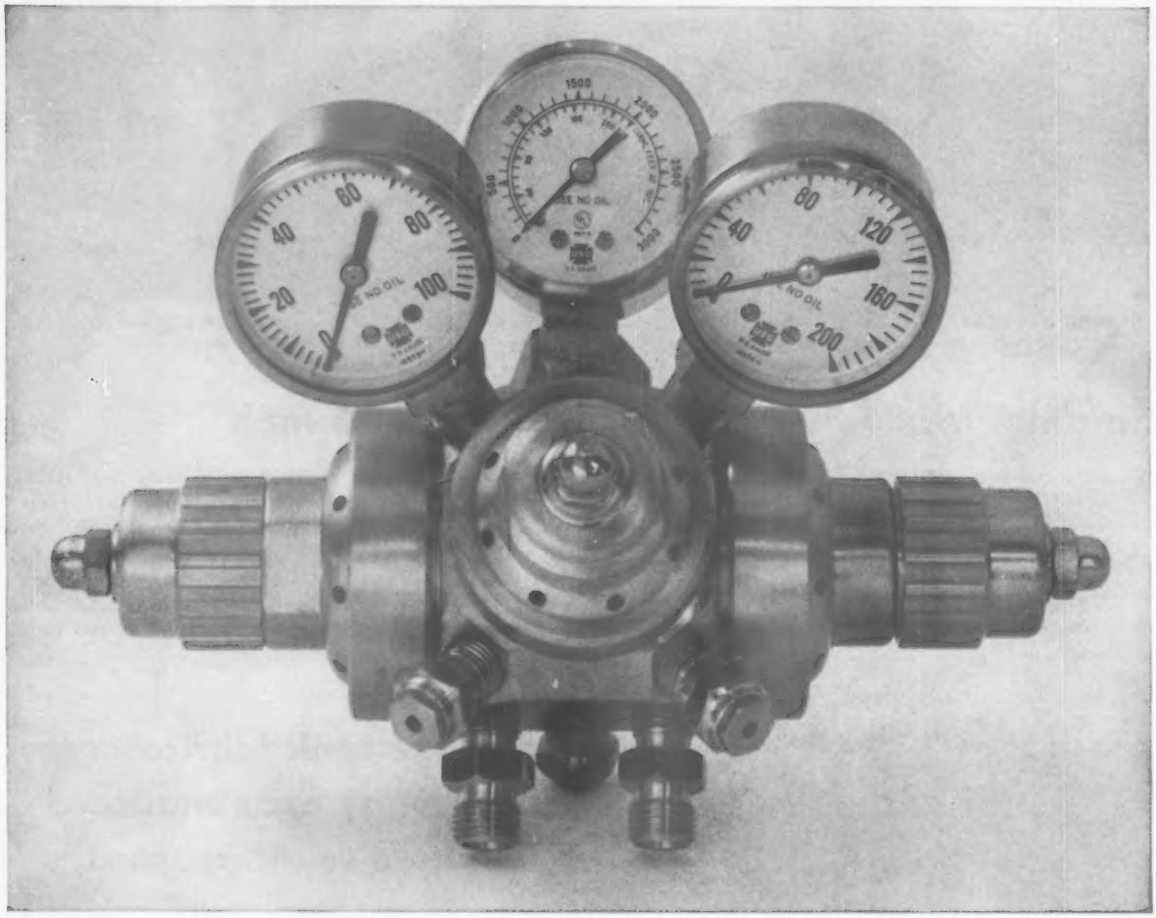
First, X-ray examination of test plates made by operators during qualification tests is faster and cheaper than the old procedure. Previously tests plates were machined and cut and coupons bent.

Second, structural attachments and parts of field-erected tanks are examined prior to delivery to the job site. Complete shop-built tanks are also X-rayed before shipment. This reduces the possibility of costly rejects after installation.

Third, all weld seams of field-erected storage tanks are inspected during construction both on a spot and continuous basis in accordance with specifications.

Portable unit shown at left is being used some 56-feet from the ground on a 1.5 million gallon water storage tank.

For Three Hose Cutting Torches . . . SEPARATE REGULATION



THE NEW TRIPLEX OXYGEN REGULATOR for three-hose flame cutting torches.

Here is a brand new regulator combining into a single unitary body one high pressure stage and two individually adjustable low pressure stages; one low pressure stage to control the preheating flame oxygen and the other one for the high pressure stream of cutting oxygen. The regulator is provided with two outlets, three self-reseating relief valves to protect each individual stage and one inlet. Three 2½" diameter gauges indicate respectively, the low pressure oxygen stream, the high pressure oxygen stream and, the center gauge, the cylinder or cylinder bank pressure. The regulator body and caps are machined of dense brass bar stock, and all internal working parts are interchangeable with all other standard regulators of comparable diameters made by our company. This new Model 5-121, National Triplex Safety Regulator will be of interest to all companies operating three-hose machine cutting torches — write for catalog FORM #16.

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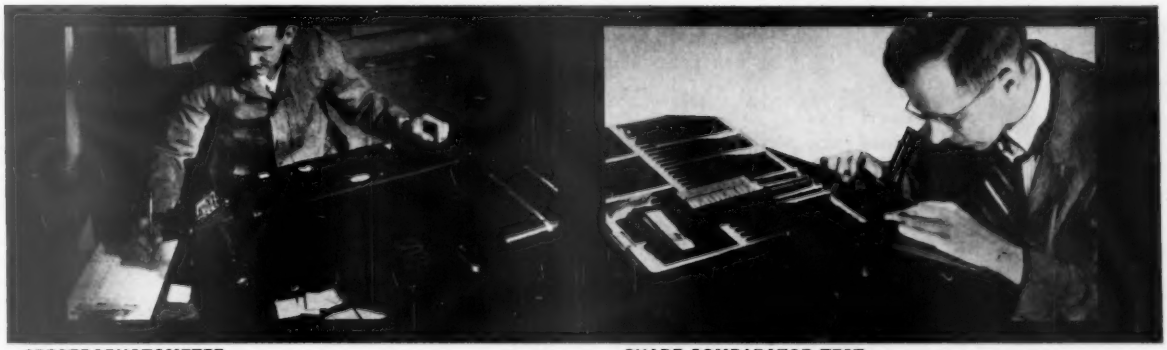
Photo Courtesy CPC Engineering, Sturbridge, Mass.

Eyes are priceless — Guard them with AO Filterweld Plates and Lenses

AO Filterweld quality glass screens out 99% or more of injurious ultraviolet and infrared radiation. It's free from striae, waves or flaws. The polished surface is without defects and the glass is unaffected by sudden temperature changes between 40° and 150° F. PLATES ARE OF THE EXACT SHADE AS MARKED. Naturally, Filterweld exceeds all existing government specifications — American Optical's long experience in the manufacture of optical glass and unsurpassed research facilities assure a premium product at a resonable price.

Shades available: 8,9,10,11,12,13. Shades 10 to 13 because of their properties and bluish-green color are exceptional for Helium and Argon Gas Shielded Arc Welding. Write for free shade selection Chart S-2393B.



SPECTROPHOTOMETER
American Optical uses this precision instrument to measure the amount of ultraviolet, visible and infrared rays transmitted. Every safeguard is taken to protect welders.

SHADE COMPARATOR TEST
This instrument was specially developed by American Optical to check absorptive lenses and welding plates for density or shade.

YOUR NEAREST AO SAFETY PRODUCTS REPRESENTATIVE CAN SUPPLY YOU

Always insist on Trademarked Welding Products

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MEN ON THE MOVE

in the welding industry

Johnson

Schneller

Crowley

Russell

APPOINTMENTS:

The following organizational changes in the sales department of the *Welding Products Division, A. O. Smith Corp.*, Milwaukee, have been announced by **R. W. Raney,** general sales manager of the division. **E. E. Johnson,** formerly chief engineer, Elkhorn, Wisconsin, plant, is sales manager-welding machines replacing **A. R. Schneller** who assume managership of the Milwaukee Distract. Johnson also assumes responsibility for the division's advertising function, replacing **R. N. Stime** who has been named A. O. Smith's assistant director of merchandising. **J. G. Crowley,** who had been Milwaukee District manager, moves to Memphis where he will be southern regional manager.

George A. Medsker has joined *Gasflux Company*, Elyria, Ohio, as vice president and sales manager. He had been with *Nelson Stud Welding Division of Gregory Industries, Inc.*

John Burke Coullard has been named sales manager of the *Electronic Controls Section of the Budd Company.* At the same time *Budd's Nuclear Systems Division* announced the appointment of **Richard P. Smith** and **Richard S. Halladay** as sales engineers.

E. S. Nuspliger, Jr., has been named director of advertising and publicity at *Metal & Thermit Corporation,* according to an announcement by **H. D. McLeese,** vice president in charge of marketing.

William C. Russell has joined the sales department of *Fibre-Metal Pacific, Inc.*, Bell Gardens, Cal. He will cover the Southern California-Arizona-Nevada territory for this newly formed subsidiary of *Fibre-Metal Products Co.*, Chester, Penna.

ELECTIONS:

Four new officers have been elected at *Lincoln Electric Co.* Named vice presidents were **Robert A. Wilson, George F. Willis** and **Edwin M. Miller. George F. Clipsham** was elected secretary.

RETIREMENTS:

Thomas M. Bohnen has retired from active service with *Whitehead Metals, Inc.*, after 45 years of service. He was the first employee of the Whitehead company upon its formation in Boston in 1914. He will continue as Honorary Chairman and Honorary Director of the company which is an affiliate of *International Nickel Co., Inc.*

PROMOTIONS:

O. M. Donohue has taken up new duties as administrative assistant, Eastern Region, *Air Reduction Sales Co.*, at Union, New Jersey. He will be succeeded as district manager of Airco's Metropolitan District, Jersey City, by **C. D. L. Perkins.**

Edward T. Scott, Jr., has been elected vice president and has been named assistant to the president in charge of sales training for *Scott-Tarbell, Inc.*, Cleveland, Ohio, welding supply distributor. Announcement was made by **Edward T. Scott, Sr.,** vice president and treasurer.

FREE DEMONSTRATION

Many of the Worthington distributors listed below have welding positioners in stock. Ask for a free demonstration.

ALABAMA
Ebbert & Kirkman Co.—BIRMINGHAM
ARIZONA
Arizona Welding Equipment Co.—PHOENIX
CALIFORNIA
W. H. Douthitt Steel & Supply—EL CENTRO
Anderson Equipment Co.—LOS ANGELES
Heidt Equipment Co.—OAKLAND
Moore's Welding Supply—SACRAMENTO
G. S. Parsons Co.—SAN DIEGO
A. G. Pond Co.—SAN JOSE
COLORADO
U. S. Welding Works—DENVER
CONNECTICUT
Zane Weldcraft Supplies—HARTFORD
FLORIDA
Kennerla Welding Supply Co.—MIAMI
GEORGIA
Keenan Welding Supply—ALBANY
Pye Barker Welding Supply Co.—ATLANTA
Savannah Oxygen & Supply Co.—SAVANNAH
ILLINOIS
Machinery & Welder Corp.—CHICAGO
A. E. Dailey Co.—MOLINE
H. R. McGarvey—PEKIN
INDIANA
Allied Weld-Craft—INDIANAPOLIS
C. A. Schrader Co.—MISHAWAKA
KANSAS
Lampton Welding Supply Co.—WICHITA
LOUISIANA
Woodward, Wight & Co.—NEW ORLEANS
MAINE
Maine Oxy-Acetylene Supply Co.—AUBURN
MARYLAND
Air Reduction Sales Co.—BALTIMORE
MASSACHUSETTS
Welders Supply Co.—BURLINGTON, CAMBRIDGE and WORCESTER
G. L. Merriam Co.—GREENFIELD
MICHIGAN
Robinson Welding Supply Co.—DETROIT
Mackay Industrial Sales—GRAND RAPIDS
Lake Welding Supply Co.—MUSKEGON
Tupes of Saginaw—SAGINAW
MINNESOTA
W. P. & R. S. Mars Co.—DULUTH
N. R. Toll Co.—MINNEAPOLIS
MISSOURI
McDonald & Wilson Sales Co.—ST. LOUIS
NEW HAMPSHIRE
N. H. Welding Supply Co.—MANCHESTER
NEW JERSEY
Mid-Jersey Equipment Co.—LIVINGSTON
Essex Welding Co.—NEWARK
NEW YORK
Mills Welding Supply Co.—BUFFALO
Le Valley McLeod Inc.—ELMIRA
Jackson Welding Supply Co.—ROCHESTER
Cotte Welding Supply Co.—SYRACUSE
General Welding Supply Corp.—WESTBURY
OHIO
Obiva Welding Co.—CINCINNATI
Scott-Tarbell, Inc.—CLEVELAND
World Electric Co.—CLEVELAND
Welders Service Co.—TOLEDO
OKLAHOMA
Oklahoma Oxygen Co.—TULSA
OREGON
J. E. Haseltine & Co.—PORTLAND
PENNSYLVANIA
Boyd Welding Co.—ERIE
Air Reduction Sales Co.—PHILADELPHIA and PITTSBURGH
SOUTH CAROLINA
Industrial Welding Supply—CHARLESTON
TENNESSEE
Oxygen Service Co.—KINGSPORT
TEXAS
Big Three Welding Supply Co.—BEAUMONT, DALLAS, EL PASO, FORT WORTH, HOUSTON, LONGVIEW, and SAN ANTONIO
UTAH
Whitemore Oxygen Co.—SALT LAKE CITY
VIRGINIA
Jones Welding Supply Co.—ROANOKE
WASHINGTON
J. E. Haseltine & Co.—SEATTLE, SPOKANE
WEST VIRGINIA
Virginia Welding Supply Co.—CHARLESTON
WISCONSIN
Machinery & Welder Corp.—MILWAUKEE
Acme, Inc.—MILWAUKEE
Van Haveren Welding Supply Co.—SHEBOYGAN
CANADA
Rudel Machinery Co.—MONTREAL, TORONTO, WINDSOR
Worthington (Canada) Ltd.—TORONTO

Circle No. 76 on Reader Service Card.

WHICH ONE OF THESE POSITIONERS DOESN'T WORTHINGTON MAKE?

Of course, Worthington doesn't make barber chairs. We really don't know anything about cutting hair . . . *but,* when it comes to positioning for welding, that's where we're right at home.

Whether you're talking about a small positioner for automatic welding of a sub-assembly, a 400-ton turning roll for a nuclear reactor, or a completely integrated push button package, Worthington is ready and able to serve you.

You owe it to yourself to investigate the profit-producing possibilities of positioning equipment—especially in these days of steadily rising labor costs and tight work scheduling. You get faster production, better and smoother welds, fewer accident hazards and less need for crane service. Every piece of Worthington positioning equipment is job-rated for extra capacity, easy installation, greater parts interchangeability and economical operation. And you can count on equally complete Worthington engineering service . . . before you buy, during installation, right through regular maintenance. Why not ask your nearest Worthington distributor or District Sales Office for more information on profitable positioning equipment. Worthington Corporation, Section 55-7, Plainfield, N. J. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON . . . FIRST IN POSITIONING FOR WELDING

WORTHINGTON

Circle No. 77 on Reader Service Card.

Introducing the NEW MODEL 1-A SEVER-ALL Machine... CUTS AT 3 to 6 SECONDS PER SQUARE INCH—ECONOMICALLY

MANY EXTRA FEATURES AT A DELIVERED COST UNDER $500

You get the cut quality and capacity of machines nearly three times as expensive when you use the new Model 1-A SEVER-ALL oscillating dry abrasive cut-off machine. Available from your distributor's stock. Here's why the #1-A SEVER-ALL is ideal for industrial and machine shop operations:

BIG CAPACITY • Up to 2″ square solids, 3½″ O. D. pipe and tubing, 3″ angle iron, and 4″ channels . . . of cold rolled, stainless, and alloyed steel; cast iron; and nonferrous metals. Wheel oscillation, an exclusive feature in this price range, provides this *above-average* capacity.

SPEED • Cuts a 2″ x 2″ hardened steel bar in 16 seconds . . . other shapes and sizes at 3 to 6 seconds per square inch.

QUALITY • Clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting.

ECONOMY • In addition to low initial cost, the Model 1-A SEVER-ALL is inexpensive to operate . . . occupies minimum floor space . . . requires little or no set-up time . . . eliminates annealing costs . . . gives more cuts per wheel because of oscillation.

SIMPLICITY • Just two SEVER-ALL cutting wheel specifications will do *all* your SEVER-ALL cutting jobs. A positive, screw-type vise holds all regular shapes, and an adjustable work stop provides speed and accuracy.

ANGLE CUTS • Optional accessory permits cutting angles up to 45° in either direction.

NEW SEVER-ALL AVAILABLE FROM DISTRIBUTORS

Very likely your own distributor already stocks the Model 1-A SEVER-ALL machine and wheels. If not, let us know, and we'll give you the name of your nearest SEVER-ALL distributor. Also, we'll be glad to send you complete details on this new machine. Just ask for **Bulletin DH-106.**

ALLISON-CAMPBELL DIVISION AMERICAN CHAIN & CABLE

925 Connecticut Avenue, Bridgeport 2, Connecticut

For More Information Circle No. 5 on Reader Service Card.

For More Information Circle No. 69 on Reader Service Card.→

Preheating carbon-moly tubing with Victor Model J27 torch and Type 28 heating nozzle at Besler Corp., Emeryville, Calif.

The man on the job likes Victor torch flexibility

Flexibility is built into all Victor torches, regardless of size. Here, for example, Series J torches are being used to preheat, then weld ⅝" O.D. with .095" wall tubing for steam generators. With a change of nozzles and tips these same torches braze and solder . . . with the addition of a cutting attachment, can be used for light cutting applications and ocasional short jobs up to approximately 2" steel.

Victor Series 100 torches for medium-duty work and the famous Series 300 for tough, heavy work, give you this same flexibility . . . heating, welding, brazing, soldering, cutting. All 3 sizes, with proper cutting attachment, can be used with oxygen-acetylene, oxygen-propane, oxygen-city or natural gas.

Ask your Victor dealer for a demonstration now. You'll see for yourself how Victor torches answer all your welding and cutting needs.

Welding ⅝" O.D. with .095" wall tube into generator coil, using Model J27 torch and Type 17 welding nozzle with oxy-acetylene.

Profitable dealerships open in a few areas; inquire now.

VICTOR for welding and cutting

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; high pressure and large volume gas regulators; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines.

62

844 Folsom St., San Francisco 7 • 3821 Santa Fe Avenue, Los Angeles 58
1145 E. 76th St., Chicago 19
J. C. Menzies & Co., Wholly-Owned Subsidiary

ATOM·ARC* Pipe Welding Alloys

*IRON POWDER LOW HYDROGEN ELECTRODES

provide x-ray quality welds—lower welding costs at

NATIONAL VALVE AND MANUFACTURING CO.

less rework, no grinding or chipping, faster deposition rates, are time savers that boost profits.

Photos Courtesy NATIONAL VALVE & MANUFACTURING COMPANY

National Valve and Manufacturing Co., fabricator and erector of quality piping for American industry, has consistently been among the leaders in the piping industry for the last half century. This large, engineering-minded organization maintains its position of leadership through research to constantly improve methods and facilities—testing and selecting the latest in materials that will provide their clients with the finest quality high pressure, high temperature piping.

NAVCO research into welding techniques and materials resulted in the selection of ATOM·ARC All Position Iron Powder Low Hydrogen alloys for handwelding of pipe fabrications and for field erection. The X-ray quality of ATOM·ARC weld metal eliminates needless rework. The flat, smooth bead contour makes slag removal easy, requires no costly and time consuming chipping and grinding, allowing weldors more time for welding. Even finish grinding of the final pass is eliminated. These cost saving properties of ATOM·ARC electrodes are amplified by the fast deposition rate achieved from the iron powder type coatings.

These are the facts NAVCO found in their search for better materials for high quality piping . . . facts which prove ATOM·ARC Iron Powder Low Hydrogen Alloys produce superior piping products. For your free copy of an informative and revealing report to piping contractors, write to:

Alloy Rods Company, P. O. Box 1828, York 1, Penna.

WORLD'S LARGEST SELECTION—IRON POWDER ALLOYS

ATOM·ARC 7018 Mo	AWS E7018-A1
ATOM·ARC 8018 N	AWS E8018-C2
ATOM·ARC 8018 CM	AWS E8018-B2
ATOM·ARC 9018 CM	AWS E9018-B3
ATOM·ARC 10018 MM	AWS E10018-D2
ATOM·ARC 12018 NMV	AWS E12018-G
ATOM·ARC "T"	AWS E11018-G
ATOM·ARC 502	AWS E502-16

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

NO FINER ELECTRODES MADE . . . ANYWHERE

For More Information Circle No. 6 on Reader Service Card.

Even the tough jobs are pushovers

Whatever the hand-cutting job . . . no matter how tough . . . this blowpipe can take it in stride. The PUROX "E" has ample capacity to slice through steel up to 12 in. thick, and all the versatility needed for piercing, grooving, gouging, rivet-cutting, and many other specialized operations. It performs efficiently on acetylene or any other commercial fuel gas, including natural gas, city gas, propane, and methane. A choice of 57 different nozzles adapts it for any practical hand-cutting need.

Choose any of four regular models now—75-, 90-, or 180-deg. head angle—to take care of your present needs. Later, you can substitute any of four different front ends at any time in order to meet new or special requirements.

See Your "LINDE" Distributor Today

for a demonstration. If you can't find his name in your telephone directory, write for it. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd St., New York 17, N.Y. *In Canada*: Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde

UNION CARBIDE

The terms "Linde," "Purox," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

For More Information Circle No. 42 on Reader Service Card.

WELDING MANAGEMENT

watches these developments

PRODUCTION OF GASES and carbide in the United States for 1958 have been released by the U. S. Department of Commerce. Preliminary reports from the Department's Bureau of Census now permit this comparison with 1957:

	Annual Production	
	1957	1958*
Acetylene (1)	10,525	10,696 million cu. ft.
Calcium Carbide	1,016,167	903,059 short tons
Oxygen, lower purity (95%)	1,148,807	1,062,265 short tons
Oxygen, high purity (99.5%)	32,803	38,042 million cu. ft.
Nitrogen	5,859	6,621 million cu. ft.
Argon	397	372 million cu. ft.
Hydrogen (2)	40,869	43,075 million cu. ft.

*Subject to revision.

(1) Excludes quantities produced and consumed by railroad shops, shipyards, and small establishments using portable generators.

(2) Excludes quantities produced and consumed in manufacture of menthanol and ammonia, but includes an unspecified amount produced for sale or interplant transfer to plants consuming this gas in the production of ammonia.

A NEW AND COMPLETE LINE *of arc welding machines is being marketed by Metal & Thermit Corp., according to A. J. Fisher, Jr., manager, Welding Division.*

The new machines will be produced to M&T specifications by three different suppliers:

Mid-States Welder Manufacturing Co. will manufacture manual AC transformer machines, DC rectifier machines, AC-DC machines, inert arc welders and auxiliary equipment in ratings from 130 *to* 500 *amps.*

Rotary motor generator welding machines will be made by Harnischfeger Corp.

Controlled arc power supply automatic and semiautomatic DC machines will continue to be manufactured for the company by Glenn Pacific Power Supply Corp., formerly M&T Welding Products, Inc.

A NEW CONTROLLED ATMOSPHERE facility at General Electric's power tube plant in Schenectady is improving the reliability and life of metal electron tubes used in welding control panels. According to D. C. Scott, tube plant manager, the new facility increases tube reliability by preventing undetected contamination from being sealed into tubes.

This is believed to be the first time atmosphere control has been used in the production of metal electron tubes, although it has long been a requirement in the manufacture of television camera tubes and many other types of receiving and transmitting tubes.

Three lines of metal tubes are being made in the new facility: ignitrons, thyratrons and phanotrons.

ENGINEERING MANPOWER TRENDS: *In the face of ever increasing challenges and opportunities for trained engineers, freshman engineering enrollment declined last Fall for the first time in eight years, according to a joint report from the Engineering Manpower Commission of Engineers Joint Council and the Scientific Manpower Commission. The final count for institutions with ECPD accredited curricula*: 59,164 (*down* 11.8 *percent*); *all others*: 10,865 (*down* 7 *percent*); *total*: 70, 029 (*down* 11.1 *percent*).

Disturbing features: *Further declines are possible in* 1959. *Although* 45 *percent of the Deans of Engineering anticipate increased* 1959 *enrollment,* 20 *percent are expecting further declines—particular in the East and Southcentral regions.*

A NEW 7-YEAR PLAN for the USSR will aim for a decided increase in the ferrous metal output of Russian mills. The following data lists the planned increases for 1965 compared with 1958:

	Output in millions of tons		Percentage: 1965 over 1958
	1958	1965	
Cast iron	39.6	65-70	64-77
Steel	54.9	86-91	57-66
Rolled metal	42.9	65-70	53-63
Iron ore (commercial)	88.8	150-160	69-80

For a report on Russian welding plans for the same seven years see WELDING DESIGN & FABRICATION for August, 1959.

STATE TAXATION *of interstate business could become a serious problem. According to a report from the National Welding Supply Association concern is being expressed about several recent Supreme Court decisions involving state taxation of out-of-state corporation activity. Decisions in the Stockham Valves and Northwestern Cement cases held that a state has jurisdiction to levy an income tax on a company organized under the laws of another state when the taxpayer's only activities were soliciting orders in the taxing state and shipping goods to customers therein.*

Several members of Congress have proposed legislation which would prevent State taxation of "income derived exclusively from interstate commerce when the only activity within said State is sales solicitation and where no office, warehouse, stock of goods or other place of business is maintained therein."

Circle No. 59 on Reader Service Card. ⟶

a frank report

by **A.O.Smith**

on new techniques and new equipment for the most advanced automatic and semi-automatic CO_2-shielded welding processes.

who's who in CO_2

. . . and from **A.O.Smith . . . .**

C-OMANUAL

C-OMATIC

C-OMANUAL BUTTON

WEL

YES! Gun-trigger welding speed

Operator works with a visible arc, welding joint always visible, no excuse for misplaced welds. The CO_2 "gun" or "head" automatically compensates for arc length, puts down metal at rates up to 30 lbs./hr. Work is never interrupted by a need to chip slag or clean flux. Just pull the trigger (or push the button) and you're off!

YES! New production flexibility

A. O. Smith CO_2 processes can be used on a wide range of gages, from approximately 0.075-inch to 1½-inch plate, on fillet, lap, butt welds, or for steel casting repair. Simplicity of operation coupled with high weld quality leads to many new applications. Operator enthusiasm for the process keeps production jobs rolling.

advantages with CO_2 ?

YES! Substantial cost savings

Process efficiency depends, of course, on proper application. When the application is right, the exceptional deposit rates, the low cost of CO_2 compared with that of other shielding gases, and the low gas consumption rate—add up to substantial savings.

YES! Strength and ductility

Use of CO_2 (carbon dioxide gas) as a shielding envelope produces welds that are strong and ductile. Extensive tests and field applications prove that the CO_2 processes are here to stay — for low-cost, high-speed welding of mild and medium carbon steel.

3 CO_2 *welding processes!*

A semi-automatic hand-gun process.

Consists of a 600-amp Constant-Potential power source; an integrated wire-drive unit; a lightweight, perfectly balanced hand gun.

A fully automatic process.

For high production mild steel welding. Consists of exceptionally efficient and dependable 600-amp CP power source; control panel; fully automatic welding head.

A semi-automatic hand-gun process.

Consists of the basic C-OMANUAL equipment, with the addition of a cycle timer and specially designed nozzle fittings. Produces button welds of all types with speed and quality.

Let's look at this A.O.Smith C-O manual !

what?

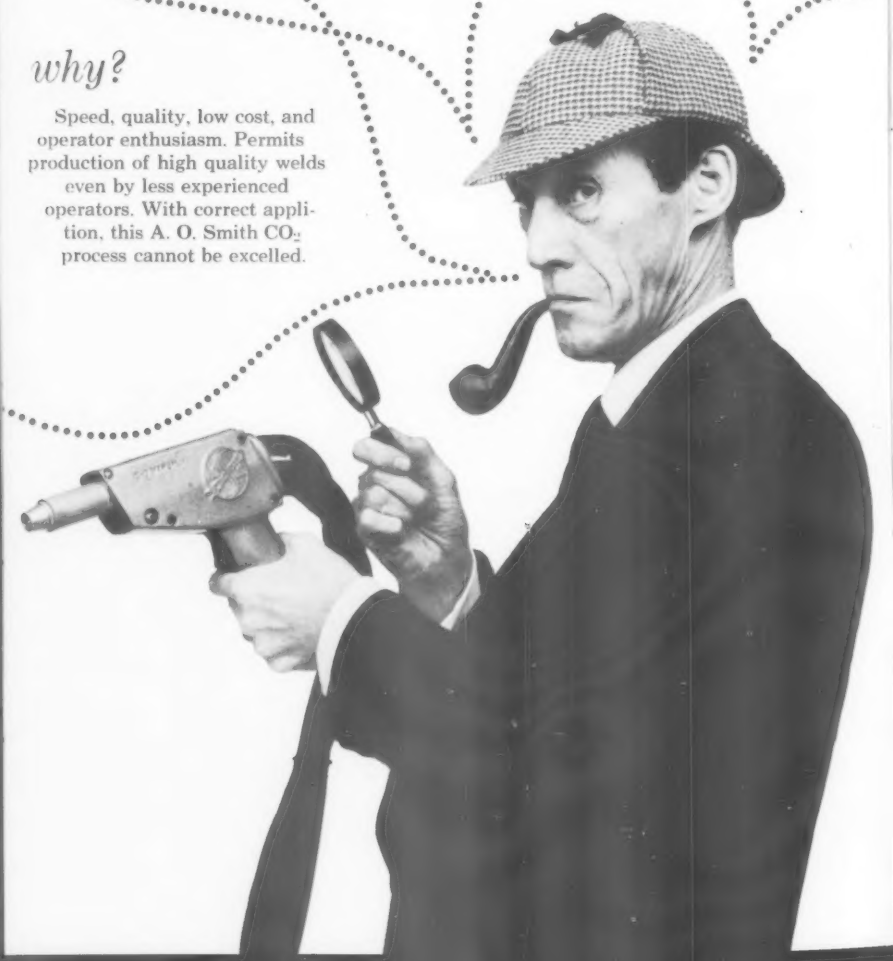
a semi-automatic hand-gun welding process that uses CO_2 as a shielding envelope with specially developed CO_2 wires . . fast, flexible, money-saving.

how?

The operator sets his voltage and wire speed, positions his gun, and pulls the gun trigger. That's all there is to it. Visible arc assures weld quality

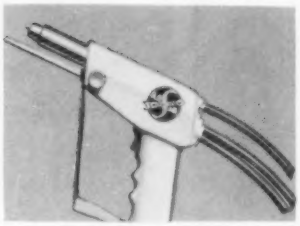
why?

Speed, quality, low cost, and operator enthusiasm. Permits production of high quality welds even by less experienced operators. With correct appli-tion, this A. O. Smith CO_2 process cannot be excelled.



GUN

Featherweight, pistol-grip hand gun (includes hose and cable assembly) — as easy to use as pointing a finger. Water-cooled, without "O" rings, it eliminates leakage troubles. All connections are fully protected. Changing wire sizes is fast and simple.



WIRE DRIVE UNIT

Can be mounted on top of power source. Consists of mechanically governed wire feed motor, gear-motor for remote wire feed speed change, dual drive wire feed rolls, post-purge gas and water timer and solenoids, safety water pressure switch, control relays.

POWER

A. O. Smith 600 amp continuous duty CP welder. Slope Control provides tap switch adjustment of output characteristics from very flat (.6 volts per 100 amperes droop) to very drooping (8 volts per 100 amperes) slope. Widest voltage range, 0 to 45.4 volts at rated load. Built-in 2 KVA—115-230 volt control transformer provides power for accessories. Fixed 180 amp connection for stick electrode tacking.

WIRE LOADING

As easy as changing a record on your record player. A. O. Smith automatic welding wire designed specifically for use with CO_2, takes only a few minutes to change. Keeps the job rolling with minimum downtime. Wire is available in reels, coils, Pay-off Paks.

THE "PACKAGE"

The complete package consists of the 600 amp Constant Potential power source, wire drive unit and hand gun, connected to the wire drive unit by gas and water hose, water cooled welding power cable, wire feed conduit cable and remote control switch. Also included are wire drive swivel mount and power cable.

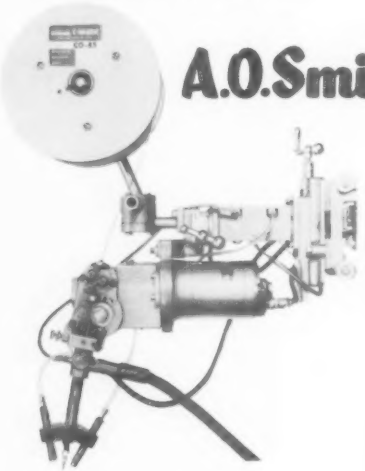
Optional equipment includes: Cooling water recirculator, CO_2 pressure regulator and flowmeter, and Stellarweld reactor which provides a variety of arc characteristics for various applications.

C-OMATIC . . . is the original fully automatic CO_2 welding process, offering all of the many advantages of CO_2 welding plus a history of automated performance unmatched in industry. Many units installed and operating every day are your assurance of satisfaction.

Primary C-OMATIC components consist of an A.O. Smith 600 ampere Constant Potential power source; compact control panel; and rugged automatic head. Secondary components include all necessary gas, water and power cables; a choice of specially designed CO_2 welding wires in any diameter and package size; all necessary fittings, gages, etc.

"*Just a voltage adjustment . . .* on the A. O. Smith 600 ampere Constant Potential power source. Two knobs on the front of the unit provide "coarse" and "fine" voltage to fractions of a volt. Slope Control provides additional voltage regulation to fit any job requirement."

A.O.Smith C-Omatic...

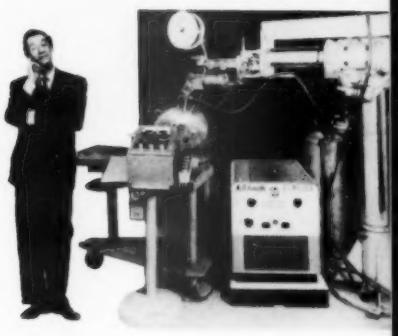


AUTOMATIC HEAD feeds weld wire ($\frac{1}{32}$-in. to $\frac{5}{32}$-in. sizes) at speeds to match job requirements. Simple adjustment for variations in the wire's lead and trail positions.

CONTROL PANEL is a portable pushbutton station for automatic operation of the welding head. Has vernier wire adjustment. Mounts easily anywhere in view of operator. Controls, stop, start, inch-up, inch-down, amperage and wire-feed speed.

Two heads **are** better than one!

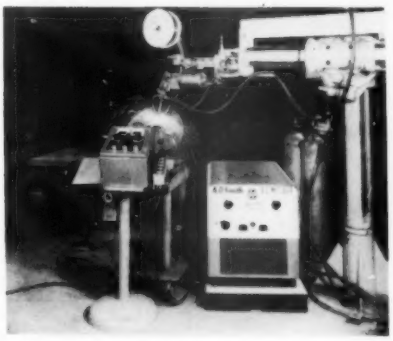
"*Just set one knob . . .*
on the compact control panel. A twist of the wrist takes care of both amperage and wire feed speed. Heavy duty start-stop buttons, a variable crater fill control, voltmeter and ammeter dials make this the simplest and most foolproof unit in the industry."



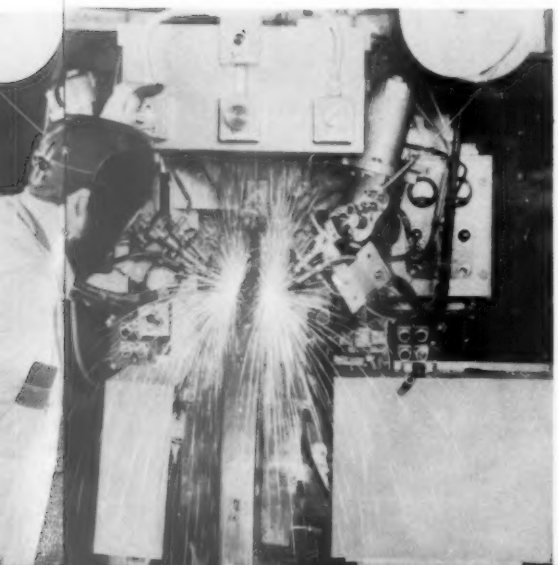
"*That's all there is to it!*
Push a button and go. Automatic head was designed for high speed production where downtime is costly. Connections are all plainly marked and keyed. Head has infinite number of adjustments. And reel changing takes only a few seconds."

full automation for CO_2 welding

POWER SOURCE is full 600-amp CP welder with the widest voltage range available — 0 to 45.4 volts. Instant striking, no sticking. Slope Control for infinite adjustment.



COMPLETE "PACKAGE" for the A. O. Smith C-OMATIC process includes CP power source, remote control panel, automatic welding head, nozzle, three position mount and all necessary hoses, cables and fittings.



TWO C-OMATIC HEADS MOUNTED FOR SIMULTANEOUS WELDING

Automotive front cross bar longitudinal weld, with the heads mounted in the 3 and 9 o'clock positions. The irregular shaped piece is rotated between the heads. At the high speed of travel (185 ipm vs. 50 ipm hand arc), the wire alignment to the seam is critical; therefore electronic tracers have been incorporated into the fixture to assure proper alignment. Tacking was eliminated.

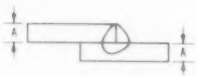
See following pages for
*Application Charts
*Physical Data

A.O.Smith

C-O manual
C-O matic

APPLICATION DATA CHARTS

LAP JOINTS



Stock Thickness A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
1/16"	3/64"	260/300	28-30	100-120	10-15° D.H.	12-19	0-10° trail
	1/16"	390/420	24-31	140-160	10-15° D.H.	12.5-17	0-10° trail
	3/64"	240/300	26-30	110-130	Flat	11-19	0- 5° lead
1/8"	5/64"	580/600	30-32	120-150	10-15° D.H.	21-28	0-10° trail
	1/16"	450/520	29-32	150-160	10-15° D.H.	18-24	0-10° trail
	1/16"	380/420	26-30	70-90	Flat	12-17	0- 5° lead
3/16"	1/16"	420/480	29-32	40-60	0-5° D.H.	17-20	0-10° trail
	5/64"	480/540	29-32	50-70	0-5° D.H.	17-21	0-10° trail

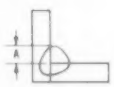
A. O. Smith automatic wire No. CO-86 was used in all the above instances.

HORIZONTAL LAP JOINTS

Stock Thickness A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
1/8"	1/16"	440/480	27-32	80-120	10-15° D.H.	16-20.5	0 to 8° trail
	5/64"	480/500	28-30	130-160	10-15° D.H.	17-21	0 to 8° trail
3/16"	1/16"	420/480	27-32	60-100	10-15° D.H.	17-20	0 to 8° trail
	5/64"	540/590	28-32	90-140	10-15° D.H.	21-27	0 to 8° trail

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

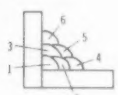
HORIZONTAL FILLETS



Fillet Size A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
1/8"	1/16"	340-380	32-34	35-45	Flat	10-14	Nozzle at 45°
1/4"	1/16"	350/400	32-34	30-40	Flat	12-16	Nozzle at 45°
5/16"	1/16"	360/420	32-36	25-35	Flat	13-17	Nozzle at 45°
3/8"	1/16"	360/420	34-38	15-20	Flat	13-17	Nozzle at 45°

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

HORIZONTAL FILLETS MULTI-PASS



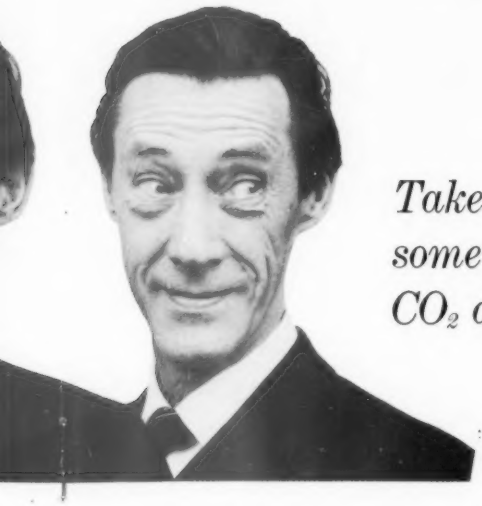
Layer	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
1	1/16"	360/420	32-35	20-25	Flat	13-17	0-5° trail
2	1/16"	370/430	33-37	25-30	Flat	13-17	0-5° trail
3 etc.	1/16"	370/430	33-37	25-30	Flat	13-17	0-5° trail

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

POSITIONED FILLETS

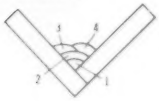
Fillet Size A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
1/4"	1/16"	420/440	35-38	25-30	Flat	14-19	0-10° trail
3/8"	1/16"	460/480	38-42	20-30	Flat	15-22	0-10° trail
1/2"	1/16"	500/520	38-42	15-18	Flat	18.5-25	0-10° trail

A. O. Smith automatic wire No. CO-86 was used in all the above instances.



Take a close look at some typical CO_2 applications

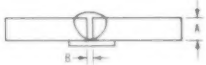
POSITIONED MULTI-PASS FILLETS



Layer	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr
1	1/16"	500/520	40-42	15-18	Flat	18.5-25
2	1/16"	500/520	40-42	10-15	Flat	20-26
3 & 4	1/16"	500/520	40-42	15-20	Flat	18.5-25

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

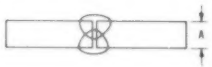
BUTT WELDS (Steel Back-up)



Stock Thickness A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Gap B	Dep. Rate Lbs/Hr	Penetration
1/8"	1/16"	430/450	29-32	65-75	Flat	0	14	100%
3/16"	1/16"	490/510	32-35	45-55	Flat	0	18	100%
5/16"	1/16"	550/570	32-35	40-50	Flat	0	22	100%
3/8"	1/16"	560/580	31-34	40-45	Flat	1/16"	23	100%

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

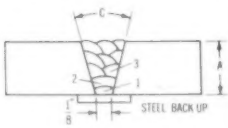
BUTT WELD (Both Sides)



Stock Thickness A	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Notes
3/8"	1/16"	410/430	32-36	20-25	Flat	12-16	Weld on both sides at the same conditions
1/2"	1/16"	480/500	32-36	15-20	Flat	16-19	Same conditions

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

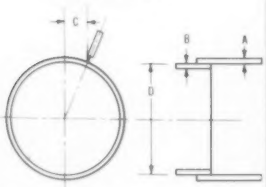
SPACED "V" BUTT WELDS



Stock Thickness A	Layer	Wire Dia.	Amps	Volts	Travel Speed IPM	Weld Position	Dep. Rate Lbs/Hr	Angle C
3/8"	1	1/16"	420-480	29-31	15-18	Flat	16-22	30°
5/8"	1 & 2	1/16"	420-480 420-480	29-31 29-31	15-20 20-25	Flat Flat	16-22 16-22	30°
3/4"	1	5/64"	440-520	37-40	10-15	Flat	17-23	60°
to	2	5/64"	450-480	35-38	7-10	Flat	17-23	60°
1-1/2"	3 etc.	5/64"	450-480	35-38	10-15	Flat	17-23	60°

A. O. Smith automatic wire No. CO-86 was used in all the above instances.

CIRCUMFERENTIAL LAP WELDS



Stock Thickness A	Stock Thickness B	Amount of Flood C	Dia. D	Wire Dia.	Amps	Volts	Travel Speed IPM	Dep. Rate Lbs/Hr
.088"	.154"	2-7/8"	12"	5/64"	550/560	30	120	19
.088"	.147"	2-5/8"	14"	5/64"	530/540	30	100	18
.101"	.161"	3"	16"	5/64"	570/580	30	100	20.5
.113"	.187"	3-3/8"	18"	5/64"	580/590	30	100	21
.123"	.204"	3-1/2"	20"	5/64"	600/610	31	100	23

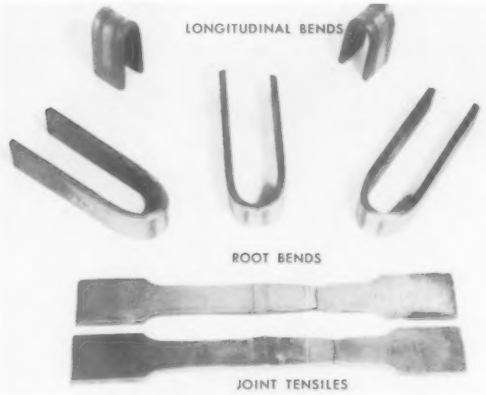
A. O. Smith automatic wire No. CO-86 was used in all the above instances.

Examine these A.O.Smith

A. O. Smith C-OMANUAL and C-OMATIC processes produce x-ray quality, low-hydrogen welds with mechanical properties equal to the best produced with coated electrodes.

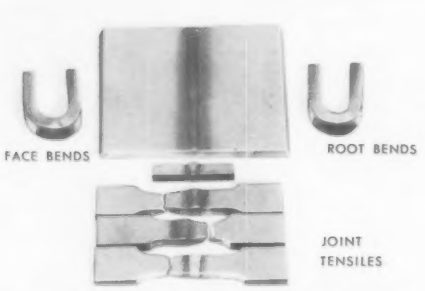
Single Pass Butt Welds

— in A-285 steel. Face and root bends indicate superior ductility. Cross section of the butt weld shows extent of penetration. Radiographs easily passed Class 1 Boiler Code standards.



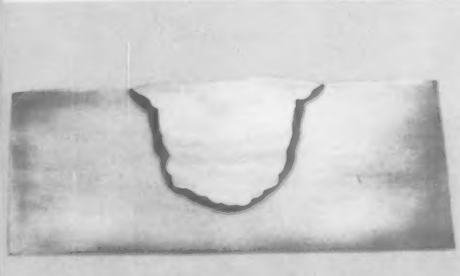
Double Pass Butt Welds

— in ⅝" medium carbon steel. Face and root bends indicate excellent ductility. Sufficient strength also, as joint tensiles failed in the stock at about 85,000 psi.



HIGH-SPEED CASTING SALVAGE

Foundries are building up blowholes and other imperfections in castings at high speed and low cost with A. O. Smith C-OMANUAL welding. Operators put down metal at rates up to 30 lbs. an hour, compared with 10 pounds or less with manual welding. Deep penetration and weld quality are assured. No flux or slag to chip. Operator can start at the bottom and work to the top without stopping.



FILLED BLOWHOLE IN CASTING
(Cross Section)

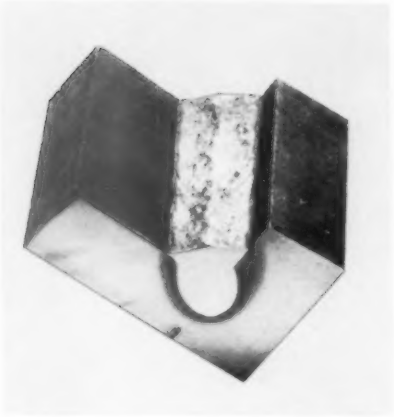
Built-up blowhole in a salvaged foundry casting is 4½" deep and 6" in diameter. On jobs like this, A. O. Smith C-OMANUAL puts down weld metal much faster than conventional electrodes.

CO_2 physicals, too

TYPICAL MECHANICAL PROPERTY TESTS

As-Welded, Not Artificially Aged

A. O. Smith Wire	Type Weld	Yield Strength	Tensile Strength	% Elong.	Red. of Area
CO-86	Butt	58,000	73,000	30.0	62.3
		60,500	72,000	28.5	61.8
CO-85	Butt	54,800	72,400	30.5	64.5
		54,300	71,900	30.5	64.9

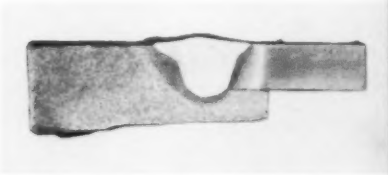


◀ POSITIONED FILLET

Single layer fillet weld deposited in ¾"-thick ASTM A-285 steel. Note depth of penetration and smooth surface appearance of the weld. A. O. Smith 1/16" CO-85 wire was used at 470 amps, 40 volts.

BEND TEST RESULTS

Welds made with the CO_2 processes were entirely satisfactory after bending to 180°. Tests proved that weld metal of excellent ductility are obtained.



▲ PENETRATION

Welds made with A. O. Smith C-OMATIC and C-OMANUAL have a wide and well-rounded weld penetration, as this photograph clearly shows.

HIGH PRODUCTION SET-UP

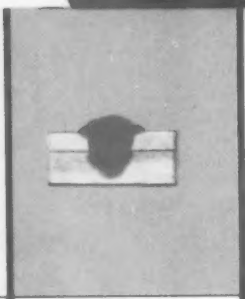
C-OMANUAL in use on X member crossbar of an automotive convertible frame. This is a high production set-up where the operator is, in effect, making an I-beam section — welding two siderails on a center web. Work is positioned for downhill (20°) welding. Speeds between 100 and 200 ipm are achieved. Work requires NO degreasing or cleaning. Slag cleaning eliminated. Virtually no rejects.

A. O. SMITH AUTOMATIC WELDING WIRE

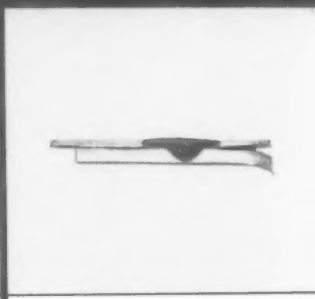
Designed specifically for top performance CO_2 welding on a wide variety of steels. Available in many diameters, packages and types.

NEW *from* A.O.Smith

Timed Fillet Button Weld



Typical Burn-Thru Button Weld



Burn-Thru Button Weld — Light Gages

Here is how you do it...

"Just slip the right button-weld nozzle over the C-OMANUAL gun barrel, tighten up the clamping screw, and the operator is set to go."

"To make a button weld, he positions the nozzle on the work, pulls the trigger, holds it until the automatic timer stops the welding. No helmet needed!"

...Button welding with a hand gun!

- A finished weld that resembles a button or rivet head.
- Made with a lightweight hand gun using the CO_2 C-OMANUAL process.
- No special training or skill required of the operator.

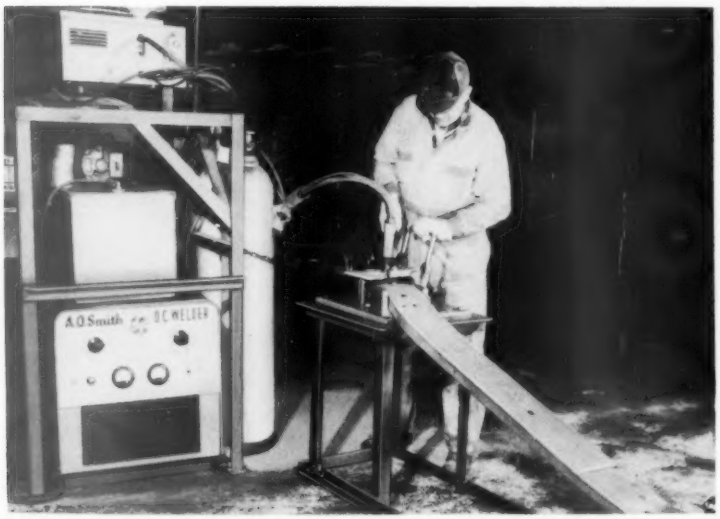
Button welding can best be described as an economical and improved substitute for spot (resistance) welding and riveting with applications far beyond those two processes.

Employing the basic C-OMANUAL equipment (see pages 4 and 5) plus a Button Welder Adapter Kit consisting of a choice of nozzles and a cycle timer, the operator merely positions his gun on the work, pulls the trigger and holds until the welding stops — automatically. Cycles can be varied from three (1/20th second) to 360 (6 seconds) depending on stock thickness (3/64" to 3/16").

Wire feed rolls are designed to feed weld wire without wire distortion. Each unit is shipped with dual wire feed rolls, including one spare, for driving 1/16" diameter wire. Rolls for 3/64", 5/64" and 3/32" diameter wires are also available.

Any of the standard joints can be button welded (lap, fillet, butt, etc.) without a need for special operator training or skills. And every "button" is exactly the same — as pre-set on the timer. There's no flux to clean — no need for a welding helmet. Operators love it.

The button weld process gives high quality weld metal, high deposition rates, deep penetration, low hydrogen weld metal, visible arc, no slag removal, and low overall costs.



No Possibility of Operator Error

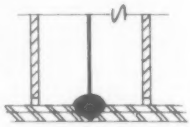
Button-welding a reinforcement bracket with the A. O. Smith CO_2 process. In this case five button welds are grouped in a relatively small area, with a simple aperture fixture used for positioning. Steel gages are 0.109 for the top piece and 0.145 for the lower piece. Each weld requires approximately one-half second (30 cycles), which is pre-set on the automatic timer. Any possibility of operator error is eliminated. Amperage: 420 at 39 volts. Visible weld, and no cleaning or degreasing of work necessary. The operator requires no helmet.

Be right on the "button" the

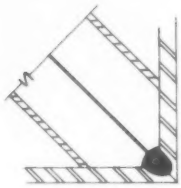
Slip-on Nozzles For Different Joints

Nozzles for burn-through button welds and fillet tack welds along with the cycle timer, are furnished with each "Button Gun" kit.

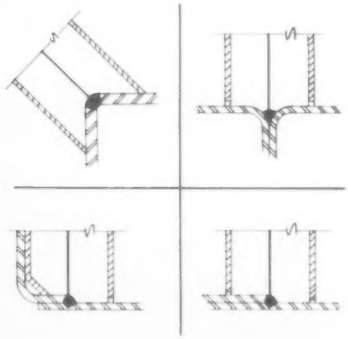
1. Standard burn-through button weld nozzle



2. Fillet Tack Button Weld Nozzle



Special nozzles for varied applications can easily be made to suit your job requirements.



A.O.Smith way

Reliability of weld quality even on uncleaned steel, extreme flexibility, and low cost of operation make A. O. Smith's CO_2 button gun a valuable new high-speed production tool. Note that it is ideal for tacking. No skill on the part of the operator is required: the supervisor sets the cycle, the operator positions the nozzle, pulls the trigger, and gets a perfect button weld every time.

CO_2 BUTTON WELDS

Stock A	Stock B	Wire	Amps.	Volts	Cycles
.081	.081	1/16"	380	37	23
.089	.089	1/16	360	37	25
.119	.119	1/16	390	37	30
.142	.142	1/16	460	40	33
.195	.195	1/16	460	47	75
.215	.215	1/16	465	48	98

CO_2 EDGE BUTTON WELDS

Stock A	Stock B	Wire	Amps.	Volts	Cycles
.081	.081	1/16"	280	40	23
.081	.081	3/64	200	37	42
.089	.089	1/16	290	40	23
.089	.089	3/64	200	37	35
.119	.119	1/16	370	37	35
.136	.136	1/16	350	37	40
.183	.183	1/16	380	37	42

Button Welding Doubles Production

Photo (at left) shows an operator button-welding a cover plate to a control arm. This job was formerly hand-arc welded at a rate of 2,200 pieces per shift. Using the button gun, the rate was upped to 4,800 pieces per shift. From 5% to 8% of the parts manually welded required repair. Only ½ of 1% of the button-welded parts required repair.

On this job two button welds are made on each piece (0.180 to 0.180 stock thickness) at ½ second each; 425 amps at 39 volts.

An interesting sidelight concerned a job requirement of 1/16" maximum button height. Problem was solved by drilling a ¼" hole in the top piece and actually inserting the wire of the button gun in the hole. The result was a virtually flat button.

YOU KNOW THIS MAN . . .

sure you do! You've seen him in the movies, on television, and perhaps on the stage. John Carradine — a star in all three mediums. During a visit to Milwaukee, he visited A. O. Smith, discovered the dramatic art of welding, and got right into the middle of it.

IF YOU have a role in which CO_2 welding can play a great part, and you want to see a try-out — call your "man from A. O. Smith."

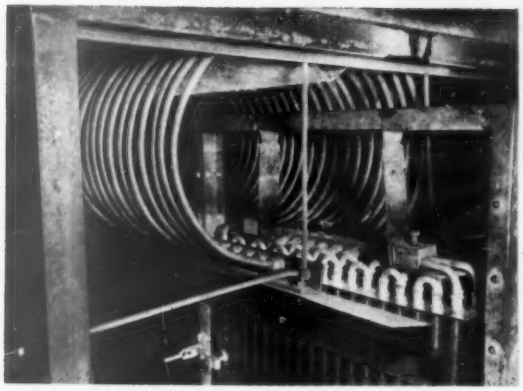
a frank report

by **A.O.Smith**

on new techniques and new equipment for the most advanced automatic and semi-automatic CO_2-shielded welding processes.

see what you can do with CO_2

If you have a problem in welding automation, remember — A. O. Smith C-OMATIC for the welding equipment and A. O. Smith Engineering Service Corporation for the fixture. There's no job too complicated and there's only one responsibility.



ALCOA develops techniques for soldering all-aluminum coils for home air conditioners.

REYNOLDS uses new type aluminum back-up bar to reduce cost of inert gas-arc welding of missiles.

U. S. uses more aluminum for civilian, defense applications

NEW APPLICATIONS for aluminum are opening up in several new fields according to almost simultaneous announcements from two of the major aluminum manufacturers.

Aluminum Company of America, Pittsburgh, announces that all-aluminum coils for air conditioners today are on the brink of general acceptance by many manufacturers. The company states that aluminum alloys and design techniques are now available to meet virtually all operating conditions. And, as a result of Alcoa recommendations, three major manufacturers currently are field testing more than 3,000 units equipped with all-aluminum coils.

The new trend represents a comeback for the light metal in the air conditioner field. All-aluminum coils were tried in the early 1950's but alloys and design techniques then available proved inadequate for corrosive conditions experienced in some environments.

Two Alcoa engineering developments set the stage for aluminum's re-entry: First, controlled service tests have shown that properly designed aluminum coils will perform well. The second development was the perfection of a zinc soldering process for successfully joining aluminum to itself, or to other metals, such as copper used in air conditioners.

In the typical application shown (above, left) the flame soldering technique is used by Chrysler Airtemp. Wire rings of solder and flux are inserted in the flared joint, where return bends are to be joined to the coil. Then the all-aluminum coil is drawn through a series of 18 flames, gradually heating the assembly to a soldering temperature of 725°F.

From Reynolds Metal Co., Richmond, comes a report that a revolutionary shift by the U. S. Armed Forces to light-weight, airborne, low-maintenance equipment is taking aluminum into hundreds of new military applications now in production or on the drawing boards.

"During 1959, several hundred million pounds of aluminum will go into equipment for national defense. In the next three years, this amount will increase substantially," said David P. Reynolds, executive vice president.

"Aluminum is now being used for every kind of military equipment imaginable from tent pegs to missiles, to combat vehicles protected by aluminum armor plate," said Mr. Reynolds.

This comes on the heels of an announcement that 1205 aluminum railroad cars will be built for the South-

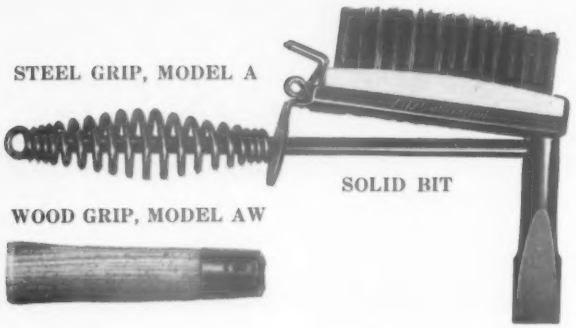
continued on page 34

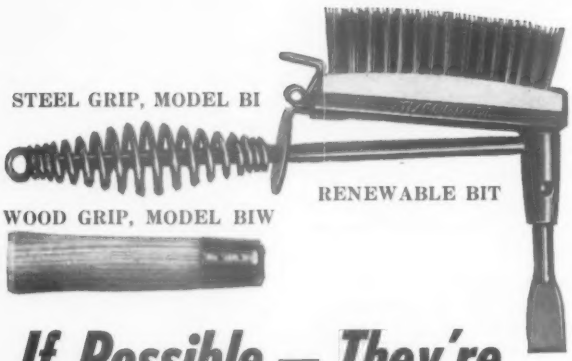
A SELF-CONTAINED TRAILER is being used by salesmen of A. O. Smith Corporation's Welding Products Division to demonstrate the company's CP-C-OMANUAL welding process at industrial plants. Each trailer, which contains all of the equipment necessary to perform on-the-spot CO_2 welding, is easily pulled from plant to plant by the salesmen's automobiles. The semi-automatic hand-gun process is used on materials up to 1½-inches thick.

←Circle No. 59 on Reader Service Card.

ATLAS | WIDE - BLADE TOMAHAWKS

WORLDS LEADING WELD CLEANING TOOLS





If Possible — They're Better than Ever!

Atlas "Dual Tools" are favorites with welders who like the idea of having the brush handy at all times. Now these tools are even more efficient than ever with our new wide blades—18% more chipping edge, more speed, fewer resharpenings, less worker fatigue. Choose your "Dual Tool" with the grip you prefer and the bit that best suits your likes. Ask your dealer for our FORM WCT-250 describing all our models.

Tough as they come!

33 MODELS

Each Atlas tool is made as well as we know how. Ask your welding supply dealer to show you the complete line.

ATLAS WELDING ACCESSORIES INCORPORATED
707 E. LEWISTON
FERNDALE 20, MICH.

For More Information Circle No. 14 on Reader Service Card.

ern Railway System. (WELDING DESIGN & FABRICATION, August, 1959, page 10). This first large volume application of aluminum by the railroad industry will require 18,700,000 pounds of aluminum plate and extrusions.

And from Reynold's missile plant in Sheffield, Alabama, comes the report of a new aluminum back-up bar for metal inert gas-arc welding of aluminum. The new back-up bar is made of a machineable alloy and has an easy to replace T-shaped stainless steel inserts. Previously, the back-up bars used in the plant were made entirely of stainless.

Charles M. Jenkins, production superintendent of missile ballistic shell plant and leader in the development of the back-up bars, said they offered two major advantages over conventional all-stainless bars. First, aluminum dissipates welding heat quicker than stainless, making unnecessary the water jackets in use of some production stake welders. Of course, faster heat dissipation also keeps distortion to a minimum. Secondly, the stainless inserts are cheap enough to be discarded after their grooves become burned and pitted.

Plant Manager M. C. Duke said the inserts can be replaced for less than half the average cost of repairing the all-stainless back-up bars. Downtime is reduced and production speeded because inserts of different groove sizes for different sheet thicknesses can be put in more quickly than if the entire back-up bar had to be switched.

The Reynolds installation produced aluminum ballistic shells for the Army Redstone missile, Jupiter C-shells and spin-launchers for the Army.

"Profit Time" Is Theme Of Belden Conference

CHICAGO, ILLINOIS: "It's Profit Time" was the theme of the District Sales Manager's Conference held here recently by Belden Manufacturing Co. Warren Stuart, sales development manager, led a program which covered past and present sales plans and discussed way to improve sales effectiveness.

more news on page 93

Circle No. 32 on Reader Service Card.

what's it to you if P&H is 75 years old?

Some companies put on years with momentum — the older they get, the faster they move. Harnischfeger Corporation — familiarly known by its trademark as "P&H" — is like that.

Over the years many P&H products have been fabricated by welding. That's how we got into the welding business: nobody else had yet built machines that welded the way we wanted, so we made a better machine than those available.

... And shared it with industry.

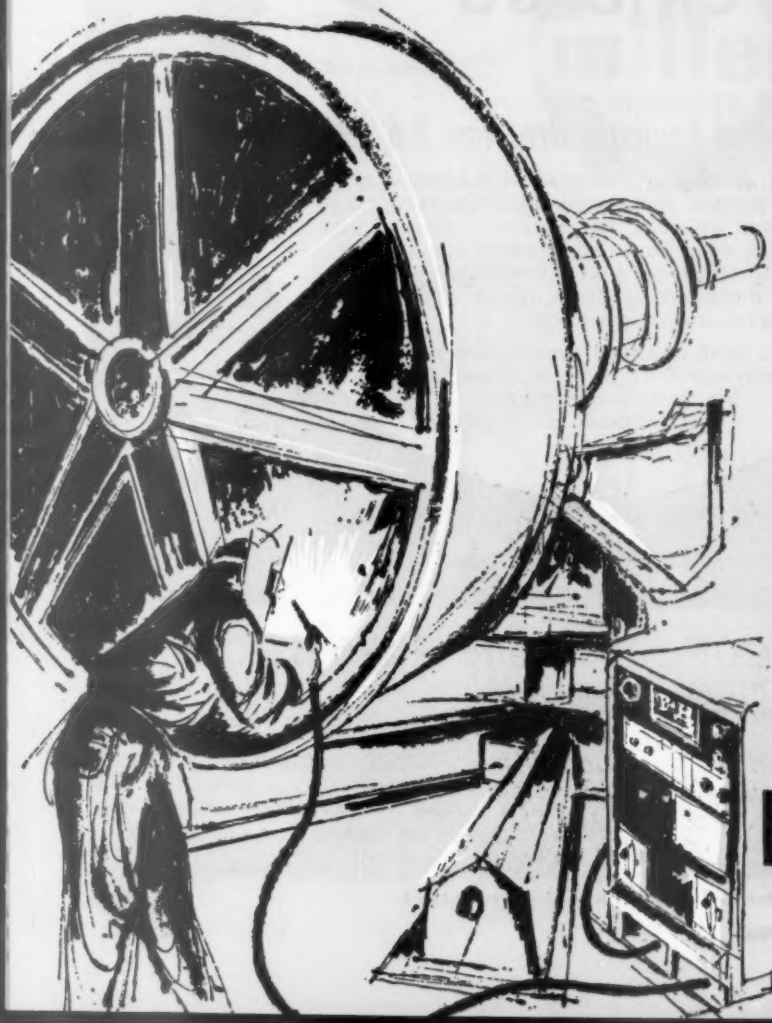
Same with electrodes: We wanted better chemistry, greater tensile strength, finer welding characteristics for fabricating our power shovels and overhead cranes, so we made them ourselves.

... And sold them to you.

When we searched for a more efficient method of weldment handling, we started making welding positioners, and we built them better than anything similar on the market.

The point is this: our welding products are the payoff on 75 years of actual metal fabrication experience. Each one—welders, electrodes, and positioners — has been tested and proved in actual production-line experience before being sold to industry. And each product has been made with the kind of quality that is bounded on the north by craftsmanship and on the south by satisfaction.

Isn't that the kind of assurance you want on your next welding purchase?



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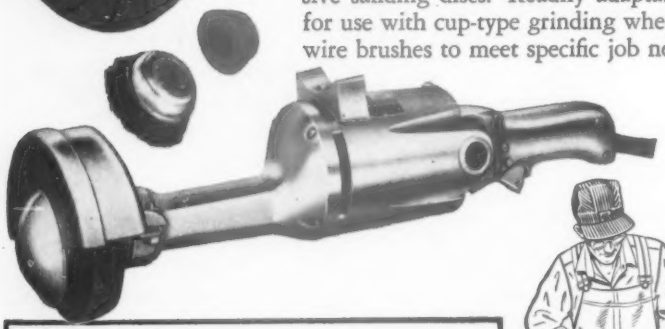

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of welding

WELDING AND BRAZING MOLY

N. E. Weare and R. E. Monroe, Defense Metals Information Center, Battelle Memorial Institute for Office of Director of Defense Research and Engineering, Department of Defense, March, 1959, 47 *pages.*

This report draws on published literature to identify the best methods for welding molybdenum to itself. It also provides guidelines for producing the most useful molybdenum joints.

Metallurgical considerations involved in joining the metal are discussed, as well as cleaning and testing techniques. Joining processes examined include fusion, resistance and solid-state welding, and brazing. The literature survey revealed that a considerable portion of valuable information concerning molybdenum has not been published as standardized data.

Order PB 151063 from OTS, U. S. Department of Commerce, Washington 25, D. C., $1.25.

COBALT (Issue 2)

Cobalt Information Center, Battelle Memorial Institute, 505 *King Avenue, Columbus* 1, *Ohio;* 59 *pages.*

The second issue of the Cobalt Information Center's quarterly, *Cobalt,* is now available.

Featured is a technical paper on newly developed cobalt-chromium-iron-base alloys with interesting oxidation, corrosion and wear-resistant properties. Applications for these alloys in the mining, extractive-metallurgy, heat-treating and gypsum industries are listed.

A paper on "Cobalt in Steels" discusses what improvements may be expected of carbon and alloyed steels with cobalt additions. "Alloys for the Aircraft Industry" reviews recent alloy developments, lists requirements for aircraft components and evaluates cobalt-containing alloys.

The 59-page issue is completed by 129 abstracts on cobalt from current literature.

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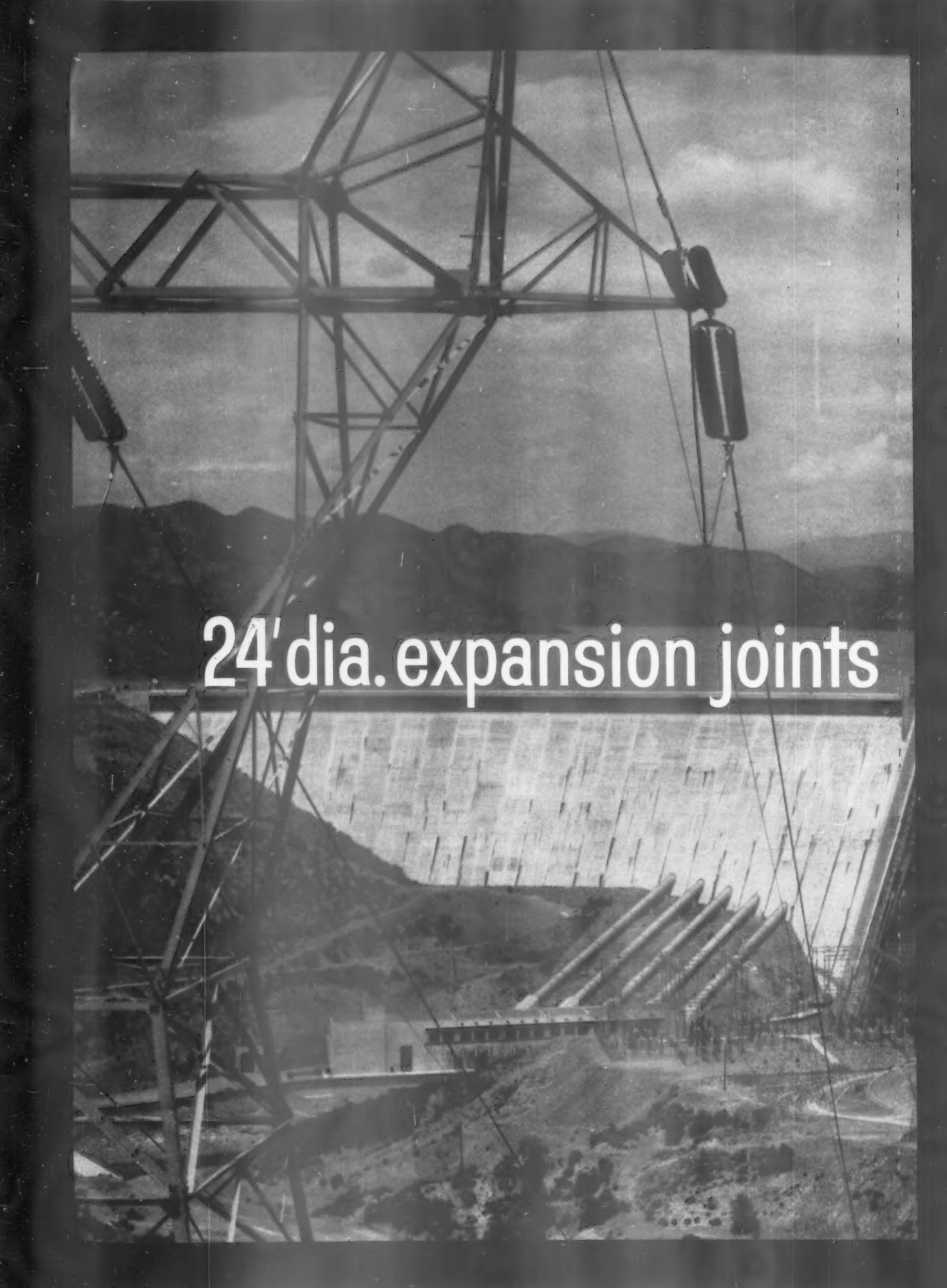
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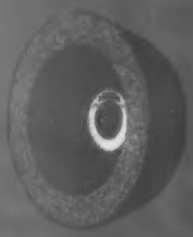

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For More Information Circle No. 57 on Reader Service Card.

SEPTEMBER, 1959
Welding Design & Fabrication
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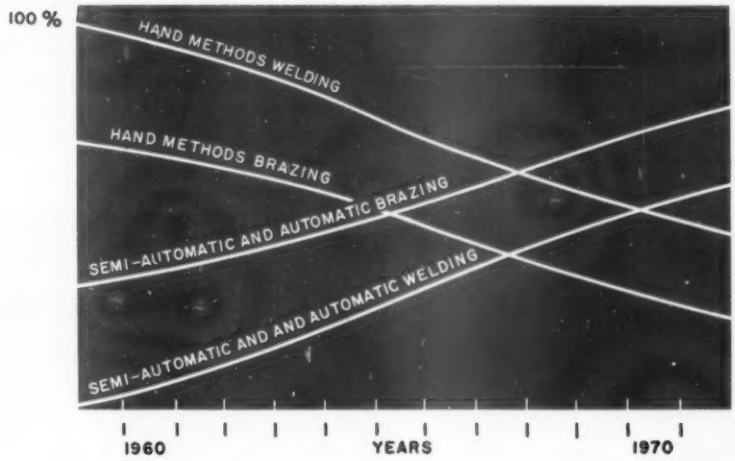
Aircraft Industry's Forecast: Much More Automatic Welding And Brazing

these changes could take place in next 10 years:



IN BRIEF: Here are the facts brought out by a 10-year forecast of trends and requirements just released by the Aerospace Industries Association. Opinions of member companies were taken and averaged out.

TWO BIG PROBLEMS are facing the aircraft industry in the next 10 years. These are the necessity for close tolerance welding and economical welding, brazing and heat treating in carefully controlled atmospheres.

WELDING:

Required for welding will the following: (1) close control of manufacturing variables, (2) improved clamping and positioning devices and (3) economical means of welding under controlled atmospheres.

■ Mechanized equipment must be developed to insure precision and consistent weld quality, particularly in applications such as the assembly of tapered sheets in dimensions of 10- by 20-feet tapering from 0.005 to 0.500-inches.

There must also be more accurate machine control of weld variables: arc volts, weld amps, weld travel and wire feed.

Equipment with travel rates of 2 to 300 ipm will have to be developed for welding molybdenum and titanium alloy sheets.

Resistance welding requirements will include a need for monitoring systems which accurately determine proper pre-weld requirement in addition to compensating for those variables in order to assure weld quality.

Development and evaluation of high frequency resistance welding is needed as well as an electronic device to control all variables in a spot welding machine.

Ultrasonic welding equipment will have to be developed to produce resistant weld-qualities and have

continued on page 68

Techniques For Resistance Welding Tiny, Dissimilar Metal Parts

IN BRIEF: A new, 5,000-square foot dust-free room with controlled humidity and temperature and specialized spot and stored energy welding techniques simplify fabrication of intricate tube mounts for electronic tubes.

FOR THE LAST 25 YEARS, 55-year-old Tung-Sol Electric Inc., of Newark, New Jersey has been making electron tubes.

With swift, accurate, decisive fingers they put together the insides (the "mount") of the tubes. This is a miniature metal structure as intricate and firmly built as the framework of a skyscraper. The mount is later sealed into the glass bulb of the tube. Every hour 7-girl teams doing six operations in sequence, make hundreds or more precise, perfect mounts.

An electron tube is an intricate device. It must be precisely built. It must be reliably built. It must be economically built. To make them you have to take human skill, precision, and care and organize them into efficient teams.

The latest facility at Tung-Sol is their new superclean tube mount department—they call it the "White Room." This 5000-square-foot room is new. It can accomodate 160 workers. They all wear white nylon smocks. Each assembly and welding unit is manned by 7 girls in white smocks. That's how the name "White Room" came about.

As you enter the department you must pass through a hall lined with nylon smocks. You take off your coat and jacket and put on a smock if you're going inside. At the entrance a blower blows off any loose dust or lint that might be on you.

SEVEN SEPARATE STATIONS are needed to complete a single tube mount assembly: First two are assembly, next four are welding (see opposite page for details); seventh is for microscopic inspection.

STORED ENERGY MACHINE is used for precise, accurate welding of four nickel mica-stops to carbonized plates of a tube mount.

The super-clean tube mount room is designed to keep components clean. If exposed to the everyday atmosphere, these small parts become oxidized, contaminated, and corroded.

To help avoid this problem, Tung-Sol keeps the room temperature at 74°F plus or minus 2°F. They also can control the humidity to under 50% with a humidistat. To help even further they change the air in the room 12 times an hour. The air is passed through an electrostatic filter that picks up particles as small as 0.001 microns. The room is kept dust-and lint-free 24 hours a day.

Materials used to make up 5687 WA tube mount are: Grid stock: chrome copper 5% moly-plated—size 0.03″ ± 0.003″, Grid connector: D-nickel—size 0.003″ x 0.020″ x 4 mm, Stop: mica size 0.005″ x 0.04″ x 3½ mm, Stem: nipron 0.020″ diameter, Getter support: nipron size 0.04″ x 6½ mm, Filament: 3.2 tungsten.

Assembly and welding: There's a lot of welding in this miniature tube mount. It takes seven separate stations to complete the assembly.

Station 1: Assembler picks up jig and assembles cathode mica assembly over jig, assembles two grids, inspects grids, assembles two plates and passes assembly on.

Station 2: Assembler picks up jig and assembles to holder, assembles top mica, removes mount from jig, bends two cathode sleeves, puts aside, assembles two cathodes to mica and positions tabs.

Station 3: Operator picks up mount, assembles and welds one grid connector (one weld), assembles and welds second grid connector (one weld), inspects, assembles and welds four nickel mica stops (four welds), pinches cathodes, adjusts and bends two cathode tabs, disposes.

Station 4: Operator assembles two filaments to two separate cathodes, inspects, assembles stem, positions and welds plate to stem (two welds).

Station 5: Operator assembles and welds getter support (one weld), positions and welds two separate cathode tabs (two welds), positions grid tabs, welds two grid tabs (two welds), inspects, passes on.

Station 6: Operator picks up mount, positions filament legs for welding, welds filaments (four welds), inspects, and passes mount assembly on.

Station 7: Inspector checks all welds of tube mount assembly through a microscope.

Welding techniques: Tung-Sol installed the most modern resistance welding equipment. To save time they have in each station two welders each serving its special purpose. They combine the resistance and the stored energy techniques to join these dissimilar metals. The chart below gives full welding details. • •

SPOT AND STORED ENERGY WELDING PROCEDURES

STATION		3		4		5		6	
TWEEZER WELDER		1½ KVA SYNCHRONOUS	STORED ENERGY	1½ KVA SYNCHRONOUS	STORED ENERGY	1½ KVA SYNCHRONOUS	STORED ENERGY	1½ KVA SYNCHRONOUS	STORED ENERGY
TUBE ELEMENTS WELDED		Chrome-copper Grids to D-nickel Grid connector tabs (2-welds)	Four nickel mica stops to carbonized plate. (4-welds)	Nipron stems to carbonized plate. (2-welds)	——	Getter support to carbonized plate (1-weld), cathode tab to nipron stem (1-weld), cathode tab to nipron stem (1-weld)	Nickel grid tabs chrome-copper grid (2-welds)	Getter to getter support (1-weld)	Tungsten filaments (4-welds)
WELD CYCLE		1	Instantaneous	3		3	Instantaneous	3	Instantaneous
WELD HEAT		70%	50%	60%		90%	50%	90%	40%
ELECTRODE PRESSURE		3-lbs.	2-lbs.	3-lbs.		3-lbs.	2-lbs.	3-lbs.	About ½-lb.
ELECTRODE	TOP	COPPER							→
	BOTTOM	TUNGSTEN							→

TABLE 1 — Results of Shear Tests on Mo-½ Ti lap joints brazed with various alloys — (Test specimens brazed in .063" sheet — overlaps approximately .100" — joint width ½" — joint clearance .002")

BRAZING ALLOY	TEST TEMPERATURE	LOCATION OF FAILURE	"INDICATED" SHEAR STRENGTH	"INDICATED" SHEAR STRESS AT FAILURE
86Fe — 14Si	Room	Braze	2,760	.....
75Fe — 13W — 12Si	Room	Braze	2,670	.....
Pure copper	Room	Parent Metal	.....	33,800
	Room	Parent Metal	.....	28,200
95Ag — 5Cu	Room	Braze	25,400	.....
		Parent Metal	.....	32,500
94Ni — 6Si	Room	Braze	11,300	.....
48Ni — 48Cr — 4Si	Room	Braze	6,500	.....
60Pd — 40Ni	Room	Parent Metal	.....	9,200
	1500°F	Braze	18,100	.....
	1500°F	Braze	15,900	.....
65Pd — 35Cu	Room	Braze	29,000	.....
	Room	Braze	33,100	.....
	1500°F	Braze	5,800	.....
	1500°F	Braze	9,400	.....
70Pd — 30Cu	700°F	Braze	16,200	.....
	700°F	Braze	14,100	.....
	1000°F	Braze	17,000	.....
	1000°F	Braze	14,800	.....
93Pd — 7Al	1500°F	Braze	13,500	.....
	1500°F	Braze	13,200	.....
	1500°F	Braze	13,300	.....

*"Indicated" shear strength is load to fracture the lap joint divided by its original shear area. "Indicated" shear stress is the similar stress present when a tensile failure in the parent metal occurred.

Will Brazed Molybdenum Replace The "Superalloys" In Jet Engine Parts?

by G. S. HOPPIN III, *Flight Propulsion Laboratory, General Electric Co., Cincinnati*

IN BRIEF: The successful application of molybdenum to many jet engine components will hinge on its ability to be brazed for high temperature service.

SATISFACTORY MATERIALS and processes exist today for brazing molybdenum for some structural applications below 2000°F. Current work is aimed at raising this figure.

This article reviews the available brazing processes the key problems and past and present work on brazing molybdenum for low and high temperature service.

BRAZING PROCESSES

Although a few relatively uncommon brazing processes cannot be used on molybdenum due to the oxidation problem, all of the major brazing processes can be applied to it: induction, torch, furnace, and resistance brazing. Work in our laboratory has shown that salt bath dip brazing also is feasible (See Figure 1).

Thorough cleaning of the molybdenum prior to brazing is required. Abrasive cleaning followed by degreasing is adequate for pure molybdenum. Electropolishing just prior to brazing has proven useful on the ½% titanium alloy. This alloy is more difficult to clean thoroughly because of titanium's surface activity.

TABLE 2 — Temperatures used for hydrogen atmosphere furnace brazing Mo-½ Ti with experimental brazing alloys.

BRAZING ALLOY	BRAZING TEMPERATURE
86Fe — 14Si	2300°F
75Fe — 14W — 12Si	2450°F
Copper	2100°F
95AG — 5Cu	1950°F
94Ni — 6Si	2300°F
48Ni — 48Cr — 4Si	2300°F
60Pd — 40Ni	2300°F
65Pd — 35Cu	2300°F
70Pd — 30Cu	2400°F
93Pd — 7Al	2150°F
70Ni — 20Cr — 10Si	2200°F
86Ni—7Cr—4Si—3B	2050°F

Furnace brazing is the only process in which heating equipment is a problem. Here work must be done in vacuo, or in inert or reducing (dry hydrogen) atmospheres.

The problem is that brazing must be done above the service temperature of the molybdenum part. If the strength of molybdenum in the 2000-2200°F range is to be exploited in a brazed part, brazing must be done at 2300°F or above. Atmosphere muffle furnaces for heating at 2300°F or above are neither common nor cheap. However, they can be built when required. Most of the brazing work reported here was done in a molybdenum heating element hydrogen atmosphere furnace with an alumina muffle. This furnace was capable of reaching 3100°F.

MAIN PROBLEMS

The main problems in brazing molybdenum are not *process* problems. Suitable processes exist (with some equipment limitations) but they do not pose basic limits. The basic limits to molybdenum brazing are caused by three metallurgical problems: (1) recrystallization of molybdenum, (2) the formation of intermetallics between molybdenum and brazing filler metals, and (3) the relative weakness of brazing filler materials at elevated temperatures.

Recrystallization's destructive effects on molybdenum and molybdenum alloy mechanical properties are well known. Recrystallization of molybdenum as a consequence of brazing can occur in two ways. If the brazing temperature and time are in a range that will cause molybdenum recrystallization, this will occur grossly and completely during brazing. Jacobson and Martin (1) reported complete recrystallization of unalloyed molybdenum in three seconds at 2700°F while induction brazing with Inconel. Recrystallization during brazing for elevated temperature service appears inevitable if unalloyed molybdenum is used and held for any appreciable time above 1800°F during brazing.

Alloyed varieties of molybdenum, with their significantly higher recrystallization temperatures, offer a reasonable good solution to this problem.

In elevated temperature service, however, the alloyed varieties are susceptible to the second, and more subtle, form of recrystallization as a consequence of brazing. Recrystallization in service occurs as a result of diffusion of brazing alloy atoms into the molybdenum adjacent to the brazed joint. Nickel is the most common base element for elevated temperature service brazing filler metals. The diffusion of nickel into the Mo-½ Ti alloy results in a gross depression of recrystallization temperature. The ½ Ti alloy will recrystallize at 2000°F as a consequence of nickel diffusion. Otherwise, it would not. As it is a localized phenomenon, service recrystallization of molybdenum due to filler metal diffusion is not as serious a problem as gross recrystallization in brazing. But, it must still be reckoned with in critical elevated temperature service applications.

The formation of intermetallics between molybdenum and brazing filler metals is harmful. The brittleness of these intermetallics may cause fractures at relatively low loads when the joint is stressed. Just as recrystallization may occur either during brazing or during elevated temperature service, intermetallics will form under either condition. If the free energy of formation is not high, they may not be microscopically detectable after brazing. But, they will form at about 2000°F where sufficient activation energy is present to allow virtually all possible metallurgical reactions to occur and proceed to equilibrium.

Elevated temperatures limit the use of brazed molybdenum assemblies because of the relative weakness of filler metals. Most of the nickel-based elevated temperature service filler materials melt in the range 1800-2100°F. This is where molybdenum's superior elevated temperature strength begins to manifest itself. Special high melting point filler materials for molybdenum are clearly indicated. Provided, of course, that they do not cause molybdenum recrystallization or form intermetallics with molybdenum. These are difficult requirements. No one material today completely satisfies all of them.

LOW TEMPERATURE SERVICE

Low temperatures are those between room temperature and 1200°F. In this range, the three basic metallurgical problems in brazing molybdenum can be neatly side-stepped. Brazing can be done well below temperatures causing recrystallization. Short brazing times will limit or prevent intermetallic formation. Little danger of service recrystallization or intermetallic formation is present below 1200°F. Finally, filler mate-

TABLE 3 — Tensile strength of butt joints brazed in Mo-½ Ti with 70Pd-30 Cu brazing alloy (Specimens were bars with .160" diameter gage length tested in vacuo)

TEST TEMPERATURE	ULTIMATE TENSILE STRENGTH (PSI)	REDUCTION OF AREA	JOINT CLEARANCE
1500°F	34,800	0	.005"
1500°F	25,200	0	.005"
1800°F	13,900	0	.008"
1800°F	9,700	0	.005"
2000°F	6,900	0	.006"

rials of reasonable strength are available for service below 1200°F.

Much of the brazing of molybdenum for "low" temperature service has been done on small parts for electronics use. Here silver and copper alloys have been primarily used.

HIGH TEMPERATURE SERVICE

High temperatures are those between 1200°-3000°F.

In this range the three metallurgical problems associated with brazing molybdenum make their appearance about 1500°F. They become progressively more troublesome as the temperature is raised. By the time the 3000°F upper limit is reached, complete recrystallization in brazing is a certainty. With the Mo-½% Ti alloy, recrystallization in brazing becomes troublesome when aiming for 2000°F service temperatures. It becomes complete when aiming for 2300°F service, presuming that brazing must be done at 2500°F to achieve 2300°F service. All of the molybdenum high temperature filler materials mentioned in available literature cause some degree of intermetallic formation with molybdenum. None have much useful strength above 2000°F.

Great difficulties are present in brazing molybdenum for "high" temperature use. Enough is known about the problems to define ideal requirements for molybdenum high temperature service brazing.

These requirements are:

(1) a molybdenum alloy which does not recrystallize during brazing,
(2) a brazing material whose diffusion will not cause recrystallization in service of the molybdenum alloy,
(3) a filler material that does not form intermetallics with the base molybdenum under any condition,
(4) a filler metal possessing useful strength at the service temperature.

The literature on molybdenum brazing was surveyed with the requirements above in mind. Johnston et al (2) mention the use of nickel and platinum for resistance brazing in the electronic industry. They performed some induction butt brazing of molybdenum bars in argon and helium and found Monel and copper the best brazing alloys, yielding room temperature joint tensile strengths of 68,000-73,000 psi. They recognized the high temperature service problem and could see no satisfactory solution.

Dike (3) at NACA surveyed the vacuum furnace brazing of molybdenum with some 28 binary, ternary, and more complex alloys. The two best of these were 84 Ni-16 Ti and 52 Cb-48 Ni. Butt joints brazed with these alloys had 1800°F strengths of about 18,000 psi. A 24 hour soak at 1800°F did not materially lower the tensile strength of these joints, although, it caused a drop from 17,000 to 7,000 psi in another promising alloy, 50 Fe 50 Pd. Photomicrographs showed that the sintered wrought molybdenum bar stock used was completely recrystallized.

Jacobson and Martin (1) evaluated molybdenum brazing with sixteen filler materials. They used vacuum furnace, oxyacetylene torch, and argon-induction brazing. Complete molybdenum recrystallization caused them to drop vacuum furnace brazing. The best 1800°F shear strengths obtained on slotted sheet specimens in their work were with Inconel (18,800 psi shear strength) and L-605 (14,250 psi) filler materials. A flux was developed for torch brazing in their work.

Tests run at 1800°F showed 100 hour shear-rupture strengths of induction brazed joints to be: Inconel—5000 psi, L-605-4500 psi.

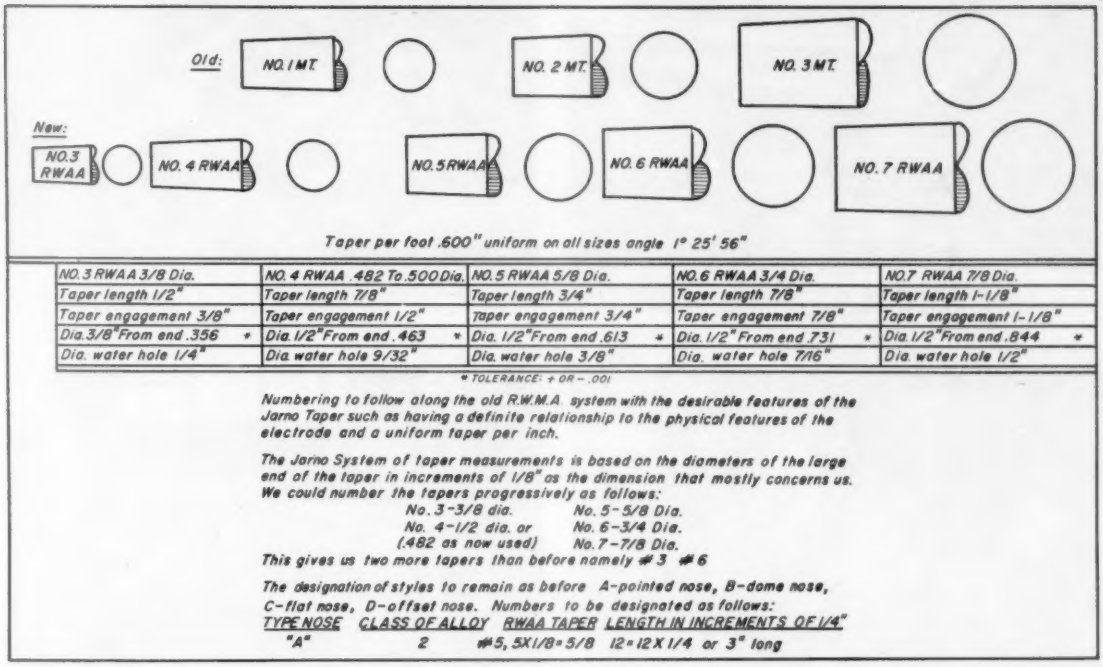
In his 1957 Climax Molybdenum publication on molybdenum joining, Freeman (4) refers to the use of molybdenum boride for 3450°F brazing of certain electronic parts. He also mentions Cu-Ni and Ni-Mo alloys for molybdenum brazing, and the brazing of molybdenum to graphite with a Au-Ni-Cr alloy.

The literature survey disclosed only a few filler materials which possessed useful strength at 1800°F. As all of the reported work was done with wrought pure molybdenum, recrystallization occurred whenever furnace brazing was used. The best filler materials reported contain elements forming intermetallic compounds with molybdenum. These are pure nickel, pure platinum, Monel, Copper, 84 Ni-16 Ti, 52 Cb-48 Ni, Inconel and L-605.

None of the filler materials reported in the literature appeared to possess the ideal requirements for elevated temperature service molybdenum brazing. So, some experimental work has been performed in our laboratory evaluating various brazing filler materials on wrought Mo-½ Ti. This alloy was chosen due to its high recrystallation temperature. Before commencing experimental work, the excellent monograph of Northcott (5) was studied to determine which elements possessed large or complete solid solubilities in molybdenum. It was reasoned that these elements would be those most desirable to use as base metals as the problem of intermetallic formation would be eliminated or minimized.

It was decided to prepare and evaluate some palladium-base brazing alloys for molybdenum. This was

continued on page 78


Old:
NO. 1 MT.
NO. 2 MT.
NO. 3 MT.
New:
NO. 3 RWAA
NO. 4 RWAA
NO. 5 RWAA
NO. 6 RWAA
NO. 7 RWAA
Taper per foot .600" uniform on all sizes angle 1° 25' 56"
NO. 3 RWAA 3/8 Dia.
Taper length 1/2"
Taper engagement 3/8"
Dia. 3/8" From end .356 *
Dia. water hole 1/4"
NO. 4 RWAA .482 To .500 Dia.
Taper length 7/8"
Taper engagement 1/2"
Dia. 1/2" From end .463 *
Dia. water hole 9/32"
NO. 5 RWAA 5/8 Dia.
Taper length 3/4"
Taper engagement 3/4"
Dia. 1/2" From end .613 *
Dia. water hole 3/8"
NO. 6 RWAA 3/4 Dia.
Taper length 7/8"
Taper engagement 7/8"
Dia. 1/2" From end .731 *
Dia. water hole 7/16"
NO. 7 RWAA 7/8 Dia.
Taper length 1-1/8"
Taper engagement 1-1/8"
Dia. 1/2" From end .844 *
Dia. water hole 1/2"
* TOLERANCE: + OR - .001
Numbering to follow along the old R.W.M.A. system with the desirable features of the Jarno Taper such as having a definite relationship to the physical features of the electrode and a uniform taper per inch.
The Jarno System of taper measurements is based on the diameters of the large end of the taper in increments of 1/8" as the dimension that mostly concerns us. We could number the tapers progressively as follows:
No. 3 - 3/8 dia. No. 5 - 5/8 Dia.
No. 4 - 1/2 dia. or (.482 as now used) No. 6 - 3/4 Dia.
No. 7 - 7/8 Dia.
This gives us two more tapers than before namely #3 #6
The designation of styles to remain as before A-pointed nose, B-dome nose, C-flat nose, D-offset nose. Numbers to be designated as follows:
TYPE NOSE CLASS OF ALLOY RWAA TAPER LENGTH IN INCREMENTS OF 1/4"
"A" 2 #5, 5X1/8=5/8 12=12X1/4 or 3" long

Here are the complete details as . . .

R.W.A.A. Proposes A New Numbering System For Resistance Welding Electrodes

IN BRIEF: A proposed numbering system simplifies an old, confusing system of taper sizes and adds two new sizes.

A NEW SYSTEM FOR NUMBERING resistance welding electrodes has been proposed by the Resistance Welding Alloys Association. According to J. C. Cox, Association president, the system would simplify an old, confusing system of sizes that had no firm foundation and would add two new sizes to the present three to keep pace with the rapidly growing resistance welding industry.

Basically, the change is being made because of a demand for a resistance welding electrode with a taper between the present #2 Morse (5/8-inch diameter) and the present #3 Morse (7/8-inch diameter). With the present numbering system this would have a 3/4-inch diameter and would be designated #2½ Morse (or some other designation) which is actually meaningless.

Actually, the new numbers would follow the old Resistance Welding Manufacturers' Association standards as to nose shape, length, etc. The only change would be in the taper size and would add the 3/4-inch diameter just mentioned, as well as a 3/8-inch size.

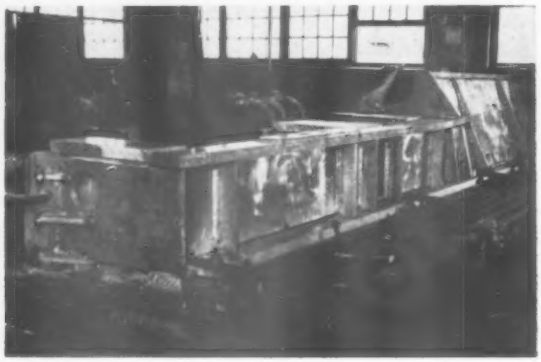
It is proposed to use the Jarno System of tapers, which have a definite relationship to the physical features of the electrode and a uniform .600-inch per foot taper, in place of the Morse System which varies from .598- to .625-inch taper per foot. This would keep within the existing limits on the taper angles so existing equipment could still be used.

The Jarno System has a definite relationship to the diameters. It is based on the diameter of the large end of the taper in increments of 1/8-inch: #3 is 3/8-inch diameter; #4 is 4/8-inch (or 1/2-inch), #5 is 5/8-inch, #6 is 6/8-inch (or 3/4-inch) and #7 is 7/8-inch. This would cover the complete range of diameters used at present and would add the 3/8- and 3/4-inch diameters.

According to Mr. Cox, the Ford Motor Company is now using the #6 size in their standards. Other automotive companies are considering its adoption.

Aiding the R. W. A. A. in preparing these new standards was Howard Alexander of Ford and Arthur Wood of P. R. Mallory & Co., Inc. • •

PIPE BENDING (left) at generating plant can be done quickly on a platen with the aid of drift pins, a bending post and a gas torch. Worn impeller (right) won't distort from buildup because it is arm-clamped during welding and cooling.



HEAVY BOLTS through the four guide rod bushings of this cracked head (left) will stop distortion during repair welding. Platens were also used by structural steel fabricator as assembly and tacking jigs for aluminum diesel engine bases (right.)

Welding Platens Can Stop Distortion

IN BRIEF: If you are welding, bending, straightening heating or assembling metals you'll find welding platens a mighty handy tool.

FEW WELDING FABRICATORS or maintenance departments can afford to be without welding platens or bending blocks. These heavy, waffle-like tables are a necessity wherever there is welding, bending, straightening, heating, or assembling.

Welding platens (the preferred name) are rigid enough to resist welding and bending stresses. They are also accurate enough to satisfy the requirements of even the fussiest drawing.

Welding platens are heavy castings (about 6 inches thick) full of equally-spaced square holes. The holes provide a way to clamp the work, prevent parts from moving. A major platen producer, Acorn Iron & Supply Co., Philadelphia, makes blocks of high tensile semisteel in six sizes, from widths as narrow as 2 2/4 ft., to lengths as long as 10 ft. A popular size is 5 ft. square.

The working surfaces are machined to within 0.005 inches of flatness. The sides are machined square with the top and have holes in them for bolting several platens together for big jobs.

The holes used for clamping, dogging, or spacing are 1¾-inches square, on 3½-inch centers. Acorn makes arm clamps, gooseneck hold-down dogs, hold-down bolts, and tapered drift pins, all adding to the versatility of the welding platens. Also, users improvise other accessories quickly and cheaply, for special clamping and bending.

Welding platens are usually supported by a heavy angle-iron frame on legs. When used in multiples, their contact points generally rest on beams and legs.

The uses for platens are many. Jobs can be small or large, important or commonplace. Missile-launching components have been built on welding platens. Simple maintenance repairs are often made on them. In either, accuracy and holding power are important.

The Cleveland Electric Illuminating Company's Eastlake Station, the firm's most modern generating plant, has frequent and critical need for their platen. When there is danger of an "outage" and the bent pipe sections have to be replaced in a hurry, the platen can be a life-saver.

An outage is serious. If generating equipment is off the line for more than two hours, that's an outage. It means the station's generating capacity is 25 per cent under par and a peak demand won't be satisfied.

When Maintenance Foreman Marty Kangas gets the urgent call about a pipe failure, he quickly inspects the ailing pipe and determines the size and contour of

continued on page 80

Some things are PRICELESS

To a drowning man nothing is more valuable than a life preserver. Every day, in thousands of shops, EUTECTIC "Low Temperature Welding Alloys" ® are just such a "Life Saver".

In maintenance shops from coast-to-coast, and throughout the world, weldors have learned to rely on EUTECTIC products. They don't count the cost of these Priceless Alloys because they know what they will do. They know that every package carries a guarantee of satisfaction, of competent service from each of 300 qualified Technical Representatives. They depend on prompt delivery of factory-fresh products, from modern warehouses, in major centers throughout the country.

You, too, can profit from 50 years of research and development by calling your nearest EUTECTIC Representative. Without obligation, he will conduct a Weld Savings Survey in your shop or plant, carry out a complete product demonstration keyed to your products and problems, and provide you with valuable technical data that will find daily use in solving your toughest welding problems.

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Cost plays no part in the selection of raw materials for the manufacture of EUTECTIC "Low Temperature Welding Alloys". Only the finest ingredients are acceptable and each product is reformulated regularly to take advantage of the latest research in product development.

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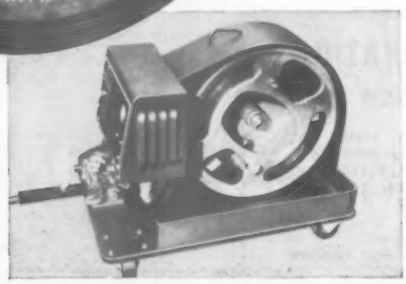
Here's a welder's own words about semi-automatic hard-facing on roll crushers..."I can do as much work in 4 hours with Stoody Semi-Automatic Hard-Facing as I used to do manually in 8 hours. The metal doesn't get as hot, and I can make a higher, wider, bead —with less effort. You just can't beat these machines for hard-facing no matter how hard you try."

If you want to cut down on your own work, if you want to *accomplish more* in a given time, you should try Stoody Semi-Automatic Hard-Facing!

We'll be glad to arrange a free demonstration in your plant, hard-facing *your* parts. You be the judge!

Stoody semi-automatic wires are supplied in continuous coils and can be fed through most standard types of semi-automatic welding machines. A wide variety of alloy types cover all job requirements.



Literature is available.
Ask your nearest Stoody Dealer or write direct to the company.

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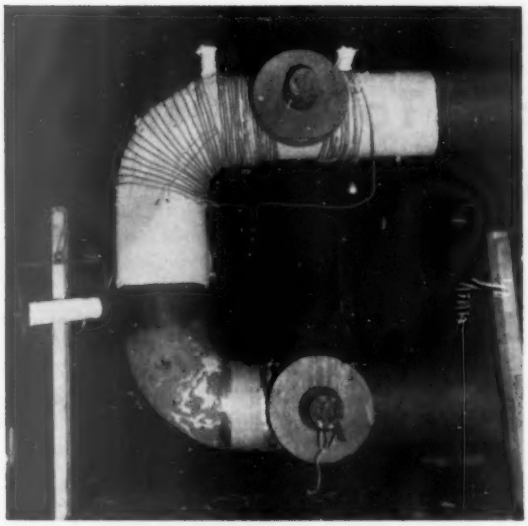

READY FOR STRESS RELIEVING, welded joint is wrapped with asbestos and heating coils and . . .

INDUCTION HEATING UNIT is set by supervisor for automatic stress relieving program.

Careful Stress Relieving Is The Key To Quality Welding Of Alloy Piping

IN BRIEF: Combustion Engineering stress relieves to get quality welds in chrome-moly and stainless piping for a 250,000 kilowatt an hour steam power generator.

CAREFUL STRESS RELIEVING helps get top quality welded piping in a steam power generator being built for the Avon Plant of the Cleveland Electric Illuminating Company in Avon Lake, Ohio, by Combustion Engineering, Inc.

All pressure piping and tubing used in the generator, which will have a 250,000 kilowatt per hour capacity, is welded. This includes superheaters, water walls, steam leads, connecting tubing and drain piping. To make sure these components will stand up under supercritical pressures (from 3800 to 4700 psi) and temperatures as high as 1110°F, Combustion Engineering makes them from thick wall chrome-moly and stainless steels.

Stress relieving is done after welding by heating the pipe to a suitable temperature (usually about 100°F below the low-critical range of the base metal), soaking for a predetermined time and allowing to cool uniformly.

According to Combustion Engineering's superintendent on the job, Joe Munder, stress relieving is used to reduce welding stresses and remove hard zones.

Key to successful stress relieving (and preheating) is the use of a 400 cycle induction heating unit. Induction coils are placed around the pipe (or tubing) and an alternating current is run through them. Induction heat is produced by a magnetic field changing direction of flow in accordance with the cycle rating of the induction unit. This alternating flow creates friction in the molecular structure of the material, generating uniform heat.

The unit can be set for a fully automatic stress relieving (and preheating) program. It has three separate, automatic controls for heating and cooling rates and soaking time.

The slow, controlled heating prevents thermal stresses from building up. Failure to control this heating rate closely could lead to thermal stresses similar to those caused by welding: a rapid and uneven expansion of the heat affected zone by a hot arc and sharp temperature gradient.

Soaking at stress relieving temperature distributes the heat evenly throughout the metal, insuring complete metal relaxation to relieve residual stresses.

Controlled cooling prevents formation of hard spots. Low Brinell hardness is gained and new stresses averted.

Joint detail: When making metal arc welds in pipe, specially designed chill rings are fitted into a recessed bore on the inside of the piping. The width of the chill ring is designed to cast a shadow on radiographic film ½- to ⅝-inch wider than the width of the groove's top when radiographic inspection is made.

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A Design Approach To Quality Control of Structural Welding

by CHARLES I. ORR, *district engineer, American Bridge Div., U. S. Steel Corp.*

IN BRIEF: The author discusses the factors which affect the quality control of structural welding: drawings, materials and materials preparation, electrodes and welding procedures and inspection and supervision.

THE STRUCTURAL ENGINEER has the first part in controlling the quality of structural welding through his design drawings and specifications.

However, the prime responsibility still rests with the steel fabricator.

SHOP DRAWINGS

This responsibility begins with the preparation of shop drawings. These must interpret and amplify the design drawings faithfully. They must show clearly material preparation, type of welds, location and extent of welds and all other information required for the fabrication of the members.

I know of cases where only very sketchy information has been sent to the shop, leaving too much to the discretion of the shop forces. This is a grave mistake and certainly does not contribute to quality welding.

Of course, the cooperation of the structural engineer is invited during the preparation of these shop details. He can help make sure that complete information for proper fabrication is shown. Sometimes changes may be made in the design of joints shown by the structural engineer. Or, detail information not shown on the engineer's design drawings may be added.

I have been advised that in some cases the inspector has been required to use the original design drawings rather than the approved shop details as a basis for inspection. I believe this is wrong. The design drawings are not the proper instrument for either shop fabrication or inspection of welded joints any more than they are for any other type of fabrication. It would be most unusual to find n set of design drawings on which all the detail necessary for shop or field welding was shown. Since the design drawings are not complete with required information, they cannot be used as a basis for inspection.

MATERIAL PREPARATION

The next important operation of the fabricator is preparing the material. This operation is no less important than the application of the weld metal itself.

The American Welding Society Code specifies re-

Designers' check list for quality control of welded structures . . .

SHOP DRAWINGS must show clearly material preparation, type of welds, location and extent of welds and all other information required for fabrication. Do not leave too much to the discretion of the shop forces.

MATERIAL PREPARATION is governed by Code specifications which give requirements for both fillet welds and groove or butt welds. Any type of joint preparation can be used if preparation and procedures are properly qualified and result in quality specified by the Code.

BASE MATERIAL offers no real quality control problems. Its compliance with specifications is determined prior to fabrication by the mill test that governs its acceptance. No further tests are required to establish its quality.

ELECTRODES are specified by ASTM Designation A233 and wire and flux for automatic welding are governed by A.W.S. Specifications for Welded Bridges.

WELDING requirements are covered in existing Codes. If all work prior to welding has been done properly, a qualified operator should have no particular problems.

INSPECTION (and supervision) is a function which should be performed as the work progresses and should be substantially complete at the same time the welding operation is.

FIELD ERECTION requires the same high quality of workmanship and inspection as shop fabrication. Joints should be designed for flat or downhand welding wherever possible.

quirements for both fillet welds and groove or butt welds. The edge preparations specified for the grooved or butt welds have been previously qualified. They result in satisfactory welds where procedures prescribed by the Code are used. The Code does not limit joint preparation to those typical joints shown in the Code, but rather permits the use of any type of joint preparation—providing that the proposed preparation and its procedure are properly qualified and demonstrated to result in the quality specified by the Code.

In the event that material preparation does not comply with the minimum requirements of the American Welding Society Code, it will be difficult to get quality welds and additional precautions must be taken. Or, the deficiencies in material preparation must be corrected.

Again, I repeat that although material preparations may not agree with American Welding Society Specifications in all respects, such material may be used in the final production providing the welding procedure, which includes such different preparations, is previously qualified.

BASE MATERIAL

While discussing material preparation, let us consider the base material. This is usually mild steel which, compared to other construction materials, offers no real quality control problems. This material is not subject to damage from splits, shakes and knots, and it is practically immune to both sunstroke and frostbite. It is a homogeneous material, so we need not worry whether its component parts are in the right proportion or in the right place.

This material is both elastic and plastic and resists stresses of tension, compression or shear equally well. It is not necessary to wait 21 days after this material is in place to find out whether it complies with the specifications. The quality of this material is scientifically controlled during production and its compliance with the specifications is determined prior to fabrication by the mill test that governs its acceptance. No further tests are required to establish its quality.

ELECTRODES

Electrodes for manual arc welding are specified under ASTM Designation A233. All electrodes in the E60XX and E70XX series are quite satisfactory for use in building construction. Electrodes must be used only with currents and polarity and in positions permitted by the ASTM Specification. Wire and flux for automatic welding are equally satisfactory if they produce deposited weld metal with characteristics set forth in the A.W.S. Specifications for Welded Bridges.

WELDING

The final operation in welded construction is the application of the weld metal itself. In the event that all work prior to this stage has been done properly, this process should present no particular difficulties to the skilled operator. Of course, all Codes require the operator to be properly qualified to perform the welding operation. He must have demonstrated his ability by satisfactorily preparing test specimens.

It has been suggested recently that sample welds of the type being made by each operator be available for his reference at all times during the progress of the work. It is quite possible that such visual reference would be helpful to operator. It would supply him with a standard of quality against which he could measure his performance. Of course, the requirements for weld quality (size, overlap, undercutting, etc.) are adequately covered in existing Codes.

INSPECTION

I should like to mention inspection in its broader sense, that is, regardless of whether this inspection is done by shop personnel or by an independent inspection agency. And, I should also like to include supervision as a part of inspection.

I do not visualize inspection as an operation which is to be performed only after all other work has been completed. Rather, I see inspection and supervision as a function which is performed as the work progresses and is substantially complete at the same time the welding operation is.

Whoever the inspector may be, he should examine carefully all detail drawings and use them as a guide. He should inspect carefully preparation and fit-up of all material prior to any welding. And, he should inspect the application of the weld metal as this work progresses. This will detect any deficiencies in the operation and permit their correction before a sizeable quantity of defective work has been produced.

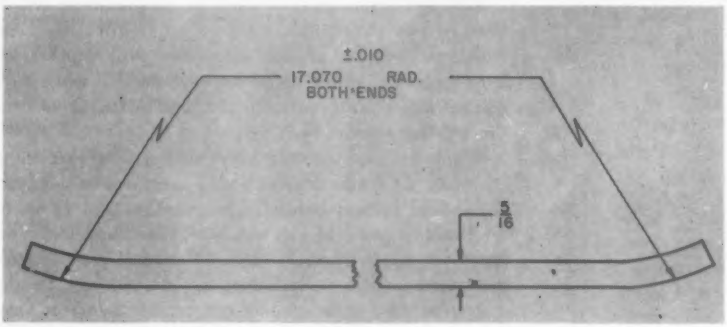
He would, of course, inspect the gouging or backchipping of butt or groove welds when and where required by the Code and the detail drawings. This must be done to make sure all material is removed down to the sound weld and base metal. This is important because I have heard specific mention made of groove welds which were lacking complete penetration. If this backchipping or back gouging operation is properly performed, and the weld metal properly deposited afterward, there can be no lack of penetration.

I have said the prime responsibility for quality control of structural welding rests with the steel fabricator. Therefore, I have no intention of attempting to assign this responsibility to the inspector under any circumstances. Although the inspector does not assume the responsibility for the quality of the work performed by the fabricator, he does have a definite responsibility to his employer, who is probably the owner or the owner's engineering representative.

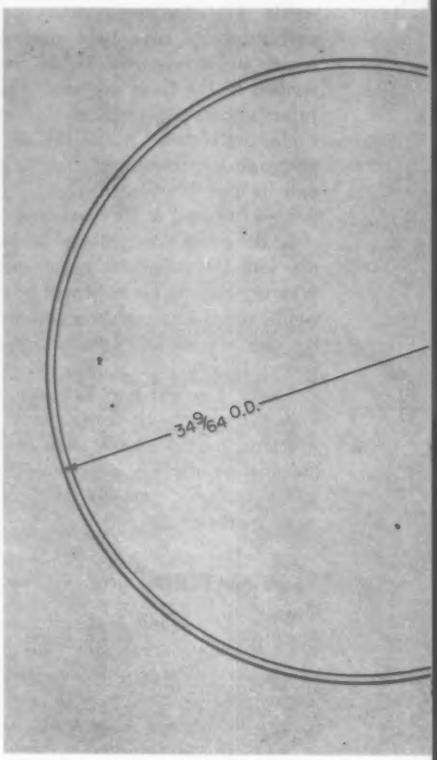
As a fabricator, my company has no objection to the presence of the owner's inspector in our shop. In fact, we welcome his services. However, we do prefer to have a competent and reasonable inspector performing these services. We want this inspector to realize his responsibilities are limited to seeing the work is performed as shown in the drawings and as called for in the specifications and the referenced Codes. It is not his prerogative to redesign the work, nor to add requirements which were not in the original contract. We also hope that our production processes will not be unduly retarded nor that our handling

continued on page 82

REDESIGNED FOR WELDING



CAREFUL edge preparation helps insure sound welds.



RING is sized and/or machined after flash butt wel

Flash Butt Welding Cuts Jet Ri

by **H. J. NOVAK,** *supervisor of welding engineering, Tapco Group, Thompson Ramo Wooldridge, Inc., Cleveland, Ohio*

IN BRIEF: A single operator now turns out 600 percent more jet engine rings; rejects have been cut from 12 percent to one-half of one percent.

EVER SINCE jet aircraft became a reality, Thompson Ramo Wooldridge has been welding components for jet engines. We used every process to weld every super-alloy or low alloy steel for components for every jet engine there is.

A process we use to cut costs is flash butt welding. We use it, for example, on the Pratt & Whitney J-57 turbojet and on the Allison J-71 turbojet. Most of the welded components are used in the compressor ends of the engines. We weld AISI 430, 403 and 410 materials to make ring-and-vane or shroud-and-vane assemblies.

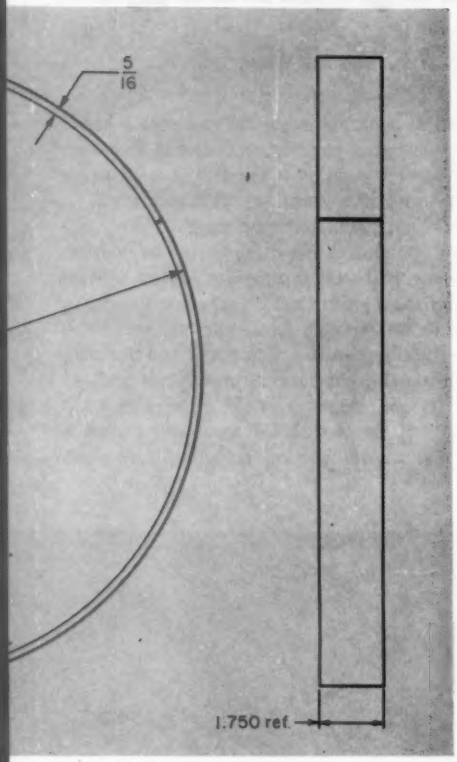
Originally, we welded them with the metallic arc process. It was not satisfactory because of tremendous grain growth. The bands broke during sizing and machining. We tried flash butt welding with special dies in a 250 KVA welder. Since then, our welded rings have been trouble free. We meet all specifications easily.

A cost study showed we saved 65 percent over manual arc welding. This startling difference was made possible by:

1. One operator (paid less than a manual arc welding operator) produces six times as many pieces.

2. Rejections were down to half of one percent. It was 12 percent with the manual metal arc process.

ABOUT THE AUTHOR: *H. J. Novak is supervisor of welding engineering for manufacturing and for research and development. Mr. Novak has had 19 years of welding experience, 12 of which were spent in actual welding. He has been in aircraft welding and engineering for the last nine years.*



TYPICAL DATA SHEET is shown at right.

g Costs 65%

We also saved time in removing flash. We remove it, and weld beads, by horizontal broaching. Our broach bars lasted much longer, too, because less material had to be removed.

We are now welding metals ranging from 0.040- to 0.500-inch. Widths vary from 5/8- to 5-inches and diameters from 10- to 40-inches.

Our flash welder can handle materials with cross-sectional areas up to 3 square inches, depending on the alloy. This welder has single platen movement for welding and single or double platen movement for upset forces. The double platen upset cycles are desirable on the super alloys.

We also use flash welding for turbine nozzle (hot end of jet engines) rings. • •

THOMPSON PRODUCTS
FLASH BUTT WELDING DATA SHEET

MACHINE MAKE SCIAKY
SERIAL NO. 6098
KVA RATING 250
MACHINE TYPE BMW3
CONTROL PANEL MAKE SCIAKY
PRIMARY VOLTAGE 460
DATE 5-18-59
STATIONARY PLATEN ☐ MOVABLE PLATEN ☒
MOVABLE ☐

"A" SIDE

B.P. NO. OF DIES
UPPER DIE RWD-163
LOWER DIE RWD-164
RWMA CL 3

"B" SIDE

B.P. NO. OF DIES
UPPER DIE RWD-163
LOWER DIE RWD-164
RWMA CL 3

MATERIAL TO BE WELDED

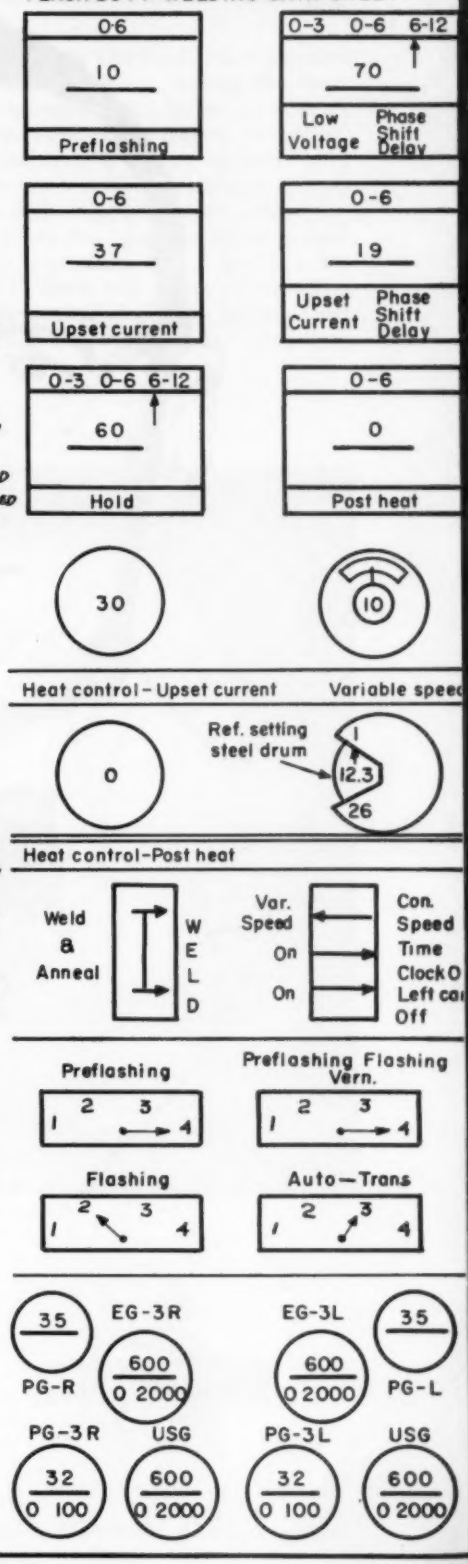
"A" SIDE	"B" SIDE
MATERIAL SIZE 1 1/2 X 5/16	MATERIAL SIZE 1 1/2 X 5/16
MATERIAL SPEC. 5627	MATERIAL SPEC. 5627
HT. CONDITION ANNEALED	HT. CONDITION ANNEALED
SURFACE COND. DEGREASED	SURFACE COND. DEGREASED
MATL. EXT. BEYOND DIES .987	MATL. EXT. BEYOND DIES .987

AREA (SQ. IN.) .468
PILOT CAM RWB-167 200° .437
TIME OF FLASHING 21.5 SEC.
AMOUNT OF FLASHING TRAVEL .437
AMOUNT OF UPSET TRAVEL .238
UPSET FORCE (LBS.) 24,000 LBS.
CLAMPING FORCE (LBS.) 50,400 LBS.
INITIAL DIE OPENING 1.975
FINAL DIE OPENING 1.300
TOTAL MATERIAL LOST .675

NOTE! AMS 7493 REQUIRES THAT ONE RING PER WELD LOT SHALL BE TESTED FOR TENSILE, HARDNESS & MICROSTRUCTURE. THE FIRST RING WELDED, IDENTIFIED BY WELD LOT CODE, SHALL BE SUBMITTED TO THE MAT. LAB. FOR TESTING. ALL RINGS WELDED ON A GIVEN SETUP SHALL BE ASSIGNED A WELD LOT CODE & THE IDENTITY RETAINED UNTIL TESTS ARE COMPLETED. ASSIGN AN ALPHABETICAL CODE, RECORD DATE, FR. & CODE. USE YELLOW DYKEM 2 TO 3" FROM WELD.

REMARKS:
SPEC. MIL-W-6873 PARAGRAPH C-4 STATES THAT AN EXPERIENCED OPERATOR SHALL SET UP A FLASH BUTT WELDER & ALWAYS UNDER THE SUPERVISION OF A WELDING ENGINEER.
SET-UP PROCEDURE
(1.) CHECK FLASHING TRAVEL & FINISH LINE ON CAM
(2.) CHECK TIME & ADJUST IF NECESSARY
(3.) CHECK UPSET TRAVEL
(4.) CHECK INITIAL DIE OPENING
(5.) HAVE ELECTRICIAN CHECK MACHINE WITH SANBORN EQUIPMENT.
(6.) HAVE INSPECTION CHECK ONE SAMPLE BY MACRO (USE TWO PIECES OF FR. 617)
(7.) KEEP DIES FREE FROM BURNOFF BY CLEANING AFTER EACH RING HAS BEEN WELDED.

MATERIALS ENGINEERING E. C. Emerson
WELDING ENGINEER - Wm Lee
QUALITY CONTROL DEPT - W. Fox
WITNESSING GOVT. INSP. - W. Fox
AUTHORIZED GOVT. INSP. - Steve Simon



How Harry Grieger

Harry F. Grieger is general manager of one of New England's thriving industrial distributing organizations, New Haven's Coe & Brown Company. In the business for more than ten years, Harry Grieger started out with a well-known competitive line of abrasive products and found they just didn't meet his standards. Switching to Bay State, he has built his business rapidly and credits Bay State products and service with a "considerable share in this company's growth."

unclogged a bottleneck at Pioneer Manufacturing

When a company has to work double shifts to keep up with customer demand, it's a pretty sure sign that the company *demands top efficiency* from its suppliers.

That's certainly the case with Pioneer Manufacturing Co., Inc. of New Haven, Conn., manufacturers of engineered sheet metal and welded products. Working with both ferrous and non-ferrous metals, they found that the weld-grinding wheels they'd been using loaded up so fast that the down-time situation was getting out of hand and weld-grinding had become an infuriating bottle-neck.

That was when Pioneer Manufacturing called in Bay State distributor, Harry Grieger, General Manager of Coe & Brown Company. He discovered that the only surprising thing about the situation was how easily it could be solved. He simply specified Bay State's Blue Flash, raised hub disc-wheels and the bottle-neck vanished . . . because Blue Flash wheels cut cost and consistently gave a higher rate of stock removal than any other wheel on the market. As a result, production zoomed, the portable grinder operators were delighted and the customer was more than slightly pleased with the improvement in the company's profit picture.

Like Harry Grieger, the Bay State distributor in your area is a trained abrasive specialist. He's as glad to tackle tough problems as he is simple ones and you'll find he's a mine of ideas on ways to improve grinding technique and cut abrasive costs . . . because *better grinding at lower cost, that is his business.*

Operator Lawrence Jennette grinds weld bead on steel brace for frame of vibration test equipment, designed for aircraft and missile manufacturers *(guard removed for photography).*

BAY STATE ABRASIVES

BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh, Los Angeles. *Distributors:* All principal cities.

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when you weld nonferrous metals you should . . .

Know Your Filler Metals

last of three parts by **ORVILLE T. BARNETT**

assistant manager, metals research, Armour Research Foundation of Illinois Institute of Technology

IN BRIEF: The author concludes this series with a discussion of the nonferrous filler metals, the important surfacing metals and tungsten electrodes. He tells where, how and why they are used.

ALUMINUM, COPPER, NICKEL, and their alloys, are the most-welded nonferrous metals. Anyone dealing with them has to know what filler metals to weld with, and what process to use.

Aluminum filler metals come as covered electrodes and bare wire. The covered types are applied by one of two processes: metallic arc or oxy-acetylene. Pure aluminum electrodes are used on many corrosion resisting jobs. Other metallic arc jobs take covered electrodes that contain about 5 percent silicon. Repair shops sometimes use the covered electrodes for oxy-acetylene welding, and they work out very well.

The giant step in aluminum welding came with the invention of the inert arc process. It was developed for welding magnesium but was soon picked up by aluminum fabricators.

Aluminum filler metal classification numbers (AWS) are prefixed with ER. This means that the bare wire may be used as a consummable inert gas electrode, as a tungsten inert arc filler rod, or as a gas welding rod. Besides the wrought wire for aluminum alloy welding you can get special cast alloys for repairing and joining castings. Foundries often pour these alloys from the same melt as the castings on which they are to be used.

Copper and its alloys. The common copper base filler metals are deposited by tungsten inert gas, consummable inert gas, oxyacetylene, manual arc (with covered electrodes), submerged arc, or carbon arc welding. Like aluminum, copper welding really boomed when the inert gas shielded processes came along.

The older processes couldn't weld copper as well because of its high heat conductivity. Even one of the best, oxyacetylene, took the steam out of an operator when he poured the heat to a joint. Covered electrode welds lack quality; the carbon arc is seldom used.

Of the inert gas shielded processes, the consummable method is the first choice where the joint has enough thickness to take the higher heats. The weld is usually better and costs less.

■ The silicon bronze copper base alloys conduct heat almost like steel. Thus, these alloys can be joined with the common welding processes. Submerged arc and inert arc are used much more than the older processes.

■ Phosphor bronze, an old standby for joining copper and its alloys, is taking a beating because of the increased use of inert arc welding. A greater variety of copper alloys can now be welded best that way with closely matching filler metals. The older metallic and carbon arc processes, of course, haven't near the usage they had in applying this metal— actually a copper tin alloy containing phosphorous as a deoxidizer.

You can gas weld with the copper nickel alloys or arc weld with them as covered electrodes. But the old story repeats, inert gas shielded welding has taken the play away from the older processes.

■ Low fuming bronze filler metals are always applied by oxyacetylene welding, usually for braze-welding of cast iron or other ferrous metals.

■ The aluminum bronze filler metals contain copper plus aluminum and sometimes iron. They can be fused with any process except gas. Their deposits resist corrosion and wear and make good bearing surfaces.

The nickel base filler metals come as covered electrodes for arc welding, or bare wire for inert arc or oxyacetylene welding. Covered electrodes are still used most but the inert arc processes are gradually cutting the lead. There is also some atomic hydrogen and submerged arc welding of the nickel alloys.

Besides the nickel base filler metals for arc and gas welding, there's a third type for inert arc welding— designed to take the higher heat. The third type cannot be interchanged with the wires intended for gas welding. See the table which lists the nickel base filler metals and the processes to use in applying them. The designer selecting filler metals for joining the nickels and some grades of stainless steel will find a lot to choose from in the nickel alloys.

Surfacing filler metals come in many forms. There are bare rods, coated electrodes, and hollow tubes filled with carbides or alloys. Every process from oxyacetylene to submerged arc welding is used; in fact, some hard surfacing welding processes were later adopted for mild steel joining. An example: the process where alloyed flux is attracted to the welding

wire by magnetism through DC welding current.

People select surfacing filler metals largely by experience. It has been very difficult to classify hard surfacing metals because many do not conform to the AWS-ASTM classifications. Neither the manufacturer *nor* the American Welding Society are at fault. Both are working towards classification standards—and it shouldn't be too long before we have them.

The hard surfacing materials that are classified are: Steels, austenitic manganese, austenitic high-chromium iron, cobalt-base alloys, carbides, copper-base alloys and nickel-chromium-boron.

■ The iron-base filler metals are either high carbon-high manganese carbon steels or low-alloy steels. The low alloy metals are manganese-molybdenum electrodes (1.75% manganese, 0.5% moly) and others that exceed the alloy content of high-speed steels.

■ Austenitic manganese steel is an old surfacing standby. You can apply it manually or automatically. The bare wire works as well, sometimes better, than the covered electrodes. But because this alloy is being used a lot, the design simplicity of the heavily covered electrode is preferred. The alloy is in the coating, the core wire is mild steel. The principle analyses, nickel-manganese and molybdenum manganese, are both good performers.

■ The austenitic high-chromium iron filler metals are popular for plow points, coke chutes, steel mill guides, and sand blasting equipment.

■ The good performance of the cobalt-base alloys on power plant and internal combustion engine valve parts is well known.

■ Tungsten carbide is the best surfacing material where there is severe abrasion. It comes as inserts or as particles filling tubular electrodes. There's a big market for tungsten carbide in oil wells and rock drilling.

■ The copper base surfacing alloys, silicon bronze, aluminum bronze, tin bronze and leaded bronze (copper-zinc), are used for bearings and for corrosion- and wear-resistance.

■ The nickel-chromium-boron filler metals are usually applied as a powder by metal spraying. However, gas welding rods and bare and coated electrodes are produced in this alloy. It's being used more and more for surfacing seal rings, cement pump screws, valve screws, conveyors, gear teeth, and scraper blades.

Though tungsten electrodes aren't really filler metals at all, they are properly included in a filler metal discussion. They are first cousins. Tungsten electrodes supply the heat for melting the filler wire (and base metal) in inert arc welding. There are three types of electrodes: pure, thoriated, and zirconium tungsten. Pure tungsten accounts for over half of industry's consumption. The thoriated tungstens are next in popularity, have improved arc stability, especially with d.c. straight polarity. Pure tungsten works well with d.c. reverse polarity and with balanced a.c. The zirconium types have intermediate uses.

Keep in mind that tungsten electrodes come in two forms—chemically clean and centerless ground. Some users say that the more expensive centerless ground electrodes have high current-carrying capacity. Try this for yourself. The material that gives the greatest economy with acceptable performance is the one you should use. • •

USE THESE WELDING PROCESSES WITH THESE FILLER METALS

COPPER BASE FILLER METALS

	Tig or Mig	Gas	Covered Electrodes	Submerged Arc	Carbon Arc
Copper	•	•	•		•
Silicon-bronze	•	•	•	•	•
Phosphor-bronze	•		•		•
Copper-nickel	•	•	•		
Low fuming bronze		•			
Aluminum-bronze	•		•	•	•

NICKEL BASE FILLER METALS

	Tig or Mig	Gas	Covered Electrodes	Submerged Arc	Atomic Hydrogen
Monel	•	•	•		
Nickel	•	•	•		
Inconel	•	•	•		
"K" Monel	•		•		
Hastelloy "B" and "C"	•		•	•	•
Nimonic "75"	•				•
Inco-Weld "A"	•		•		

The Strength Of Arc Welded Joints

IN BRIEF: Here are the elementary principles involved in calculating nominal stresses in welded joints and determining their strength.

ARC WELDED JOINTS are classified into several different types. Each of these can be made with several different types of welds. The arc welded joints and welds that are used most commonly in fabricated structures and weldments are defined and illustrated here. Descriptions and examples of the conventional methods used for analyzing such joints in design are given. The type of welded joint or weld to be used in any particular case may be determined by consideration of cost. Or, perhaps by technical considerations based upon characteristics of the loads to be carried or other service conditions of the part being designed.

The actual patterns of localized stresses in either welded joints or riveted or bolted joints are quite complex. For all of these, however, simplified conventional methods have been adopted as standard design practices, for which it is assumed that the welds, rivets or bolts and adjacent base metal are stressed in simple tension, compression or shear. The kind of stress involved depends upon the type of joint, the type of weld or fastener and the directions of the forces acting upon the joint.

The standard types of joints and welds and the methods for their analysis have been developed and investigated thoroughly by research and experience, including many tests to failure. These have demonstrated that standard conventional methods of analysis are suitable. Experience has shown that the standard types of joints can be made in a practical manner with the kinds of welds that conform to standard practices for each type of joint. With suitable practical welding procedures, sound welds can be made. Provided that the arrangement of parts to be joined affords suitable accessibility and visibility.

If a proposed arrangement of parts requires geometric shapes of joints or welds that do not conform to standard types, this is almost surely an indication that the proposed scheme is at least impracticable under most circumstances, if not impossible of being made in a reliable manner.

EDITOR'S NOTE: This article is based on material included in the booklet "Arc Welded Joints" prepared by LaMotte Grover and published by the Arc Welding Section of the National Electrical Manufacturers Association.

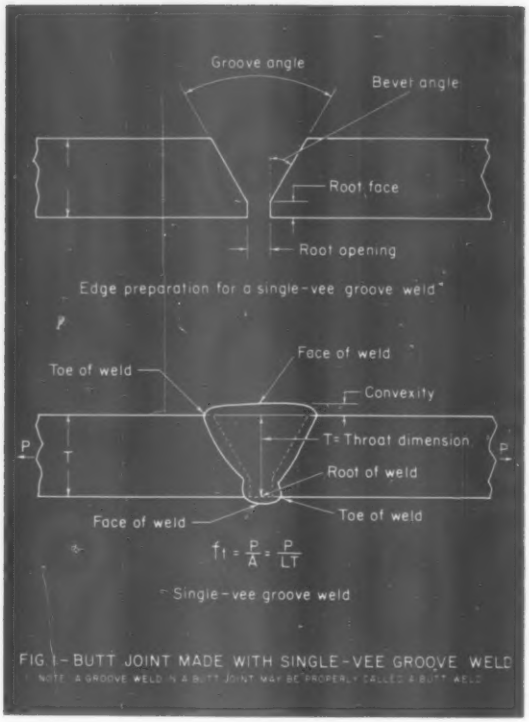


FIG. 1 – BUTT JOINT MADE WITH SINGLE-VEE GROOVE WELD
NOTE: A GROOVE WELD IN A BUTT JOINT MAY BE PROPERLY CALLED A BUTT WELD

BUTT JOINT:

The most simple type of arc welded joint is the butt joint, Fig. 1, in which two edges are suitably squared, beveled or chamfered and joined together by welding. The types of welds used for this joint are all called groove welds (they may also be called butt welds in the case of a butt joint). The type of weld illustrated is a single-vee groove weld. If the material is thin enough to permit adequate penetration without the beveling of the plate edges, they are simply squared to fit properly (sometimes in contact with each other prior to welding), and the weld is called a square groove weld.

The butt joint is the most efficient type of welded joint. For most applications it is considered to have 100% efficiency and there is no need for computing the unit stress because the weld is at least as strong as the material joined. Under special circumstances, the specifications may require the use of a lower allowable unit stress than that for the base metal, for example in the case of parts subjected to many repetitions of a wide range in stress (fatigue). The unit stress on the weld is computed on the basis of the cross sectional area of the adjacent base metal parts—the thinner of the two parts joined, when they are of different thicknesses.

The unit stress is computed by the simple equation:

$$f = P/A \qquad (1)$$

in which f is the unit stress, P is the total force or total stress on the joint and A is the nominal throat area of the weld, its length, L, multiplied by its nominal throat dimension, T, which is the thickness of the base metal. Therefore A is the product of the width and

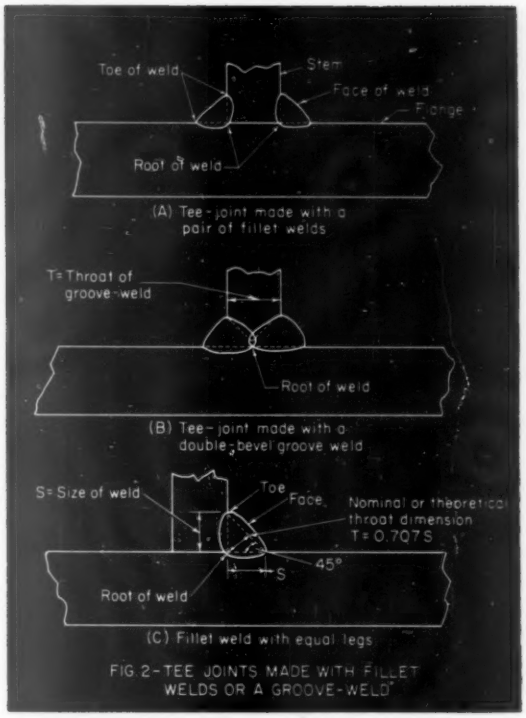


FIG. 2–TEE JOINTS MADE WITH FILLET WELDS OR A GROOVE-WELD

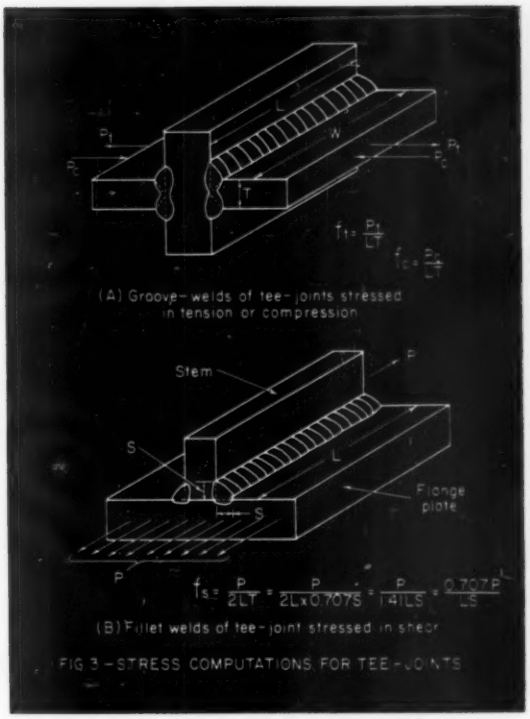


FIG. 3–STRESS COMPUTATIONS FOR TEE-JOINTS

thickness of the bar or plate. The stress, f, will be either tension, compression or shear, depending upon whether the direction of P is such as to cause tension, compression or shear on the throat area of the weld.

TEE-JOINT:

The most efficient manner, and usually the only proper manner, of making an arc-welded tee-joint, Fig. 2, is to weld the two parts together directly. No connection material is required, such as the connection angles used in riveted or bolted joints. The joint is usually made by depositing two welds of triangular cross-section, called fillet welds, one on either side of the stem of the tee, Fig. 2(A). Under some circumstances a groove weld may be preferable, Fig. 2(B). In this case the stress in the groove weld is computed in the same manner as for a groove weld used in a butt joint. The cross-sectional area, A, of equation (1) is simply the product of the width and thickness of the bar or plate forming the stem of the tee.

In the case of a fillet weld, Fig. 2(C), the critical or weakest section, for which the unit stress is computed, is assumed to be the effective length of the weld multiplied by its nominal throat dimension, T. This throat or throat dimension is the distance from the root of the weld perpendicular to the hypotenuse of the largest right-triangle that can be inscribed within the fillet-weld cross-section, Fig. 2(C). Even though the actual throat is somewhat greater, due to convexity of the surface or face of the weld, this convexity is neglected in stress calculations. However, as indicated by the description of the nominal throat dimension, concavity of the weld surface is taken into consideration.

Since fillet welds with equal legs are nearly always used in design, and since the parts being joined nearly always intersect at an angle of 90 degrees, the nominal throat of a fillet weld is usually equal to its leg size, S, multiplied by 0.707, the sine of 45 degrees. It is standard practice to designate the size of a fillet weld by the length of its leg, rather than its throat, because it is easier to make a reliable measurement of the leg with a weld gage.

The cross-sectional area of a pair of fillet welds, Fig. 3(B), is 2LT, in which the throat, T, is equal to 0.707S.
Therefore,

$$f_s = \frac{P}{1{,}414LS} = \frac{0.707P}{LS} \qquad (2)$$

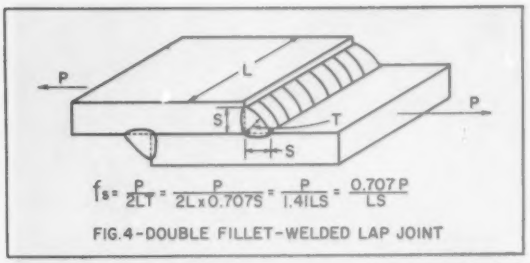
in which f. is the unit shearing stress in the weld.

Design specifications provide that the stress in a fillet weld shall be considered as shear on its throat area, for any direction of applied load. Therefore, if the joints illustrated in Fig. 3(A) as subjected to tension or compression forces, were to be made with a pair of fillet welds for each joint, in lieu of groove welds, the applied load or force would be resisted by the throat areas of two fillet welds.

$$f_s = \frac{0.707P_t}{LS} \text{ or } f_s = \frac{0.707P_c}{LS}$$

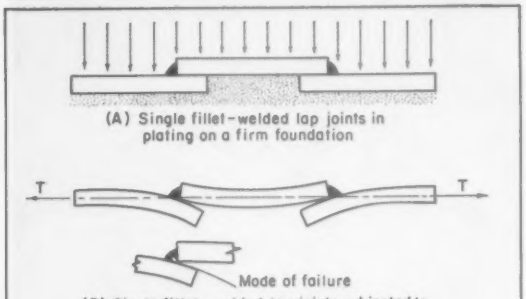
Sometimes plating may have to be joined to a com-

continued on page 64



$$f_s = \frac{P}{2LT} = \frac{P}{2L \times 0.707S} = \frac{P}{1.41LS} = \frac{0.707P}{LS}$$

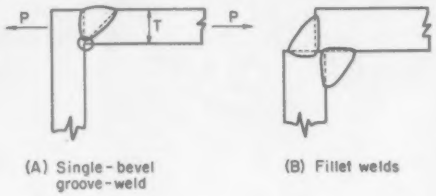
FIG.4-DOUBLE FILLET-WELDED LAP JOINT



(A) Single fillet-welded lap joints in plating on a firm foundation

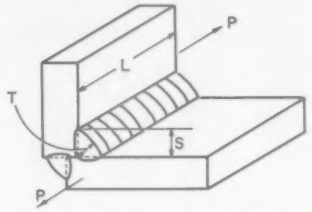
(B) Single fillet-welded lap joints subjected to tension and bending action

FIG.5-SINGLE FILLET WELDED LAP JOINTS



(A) Single-bevel groove-weld

(B) Fillet welds



$$f_s = \frac{P}{2LT} = \frac{P}{2L \times 0.707S} = \frac{P}{1.41LS} = \frac{0.707P}{LS}$$

(C) Fillet welds stressed in shear

FIG.6-CORNER JOINTS

ARC WELDED JOINTS *continued from page 63*

paratively thick stiffener bar which constitutes the stem of a tee-joint, where there is not good access for making fillet welds as shown in Fig. 3(B). In such a case, a row of holes can be punched or drilled in the flange plating along the line of contact with the edge of the stem or stiffener bar. Weld metal deposited in these holes and fused to the edge of the stem can be used to join the two parts together. Such welds are called plug welds.

The effective area of a plug weld for resisting stress is considered to be the nominal cross-sectional area of the hole in the plane of the contact surface. To gain additional area the holes may be slotted, in which case the welds are called slot welds. Plug and slot welds are seldom used for important joints in dynamically loaded structures. They are used principally to transfer substantially static shear stress, or to prevent buckling of component parts of a member.

Groove welds should be used whenever possible to resist tension stress in a joint that is subjected to fatigue, with many repetitions of a wide range of stress. The fatigue resistance of a joint made with fillet welds, plug welds or slot welds is reduced a good deal by stress concentrations, which occur at any abrupt discontinuity in surface, such as the toes or roots of fillet welds or around the edges of plug or slot welds, just as they occur around rivet or bolt holes. In fatigue tests, failure often occurs in the main material adjacent to such stress concentrations, rather than in the welds, rivets or bolts, themselves, when the joint is proportioned as required for static loading.

LAP JOINT:

Sometimes it is impracticable to use the more efficient groove-welded butt joint to weld two edges together, and a lap joint, Fig. 4, is used. Such joints are usually made with fillet welds, as illustrated, although they can be made with plug or slot welds, by punching one or more rows of holes near one of the plate edges and filling them with metal fused to the contact surface of the other plate. Instead of filling the entire areas of holes or slots with weld metal, fillet welds may be made around the peripheries of the holes or slots. The welds are then called fillet welds rather than plug or slot welds. In any of these types of arc welded lap joints the welds are considered to be stressed in shear to transmit the applied load across the joint.

Since fillet welds are always considered to be stressed in shear on the throat area, the weld stress of the double fillet-welded lap joint of Fig. 4 is calculated by the expression:

$$\frac{P}{f_s\, 1.414LS} = \frac{0.707P}{LS}$$

Sometimes single fillet-welded lap joints are used under circumstances that would not tend to subject them to an unfavorable bending action. For example, the bottom plating of a storage tank on a firm foundation, Fig. 5(A).

However, when the joints are subjected to tension, Fig. 5(B), and the plates are not restrained from the kind of deflections shown, the bending will tend to produce concentrated tension at the roots of the fillet welds and failure in the manner illustrated in Fig. 5(B). Single fillet welded lap joints should not be used in such cases.

CORNER JOINT:

Corner joints may be made with fillet welds or with

various kinds of groove-welds. A single-bevel groove-weld is shown in Fig. 6(A), and a pair of fillet welds in Fig. 6(B).

When a double-fillet welded corner joint is stressed in shear, Fig. 6(C), the unit stress is the same as for a double-fillet-welded tee-joint or a double-fillet-welded lap joint.

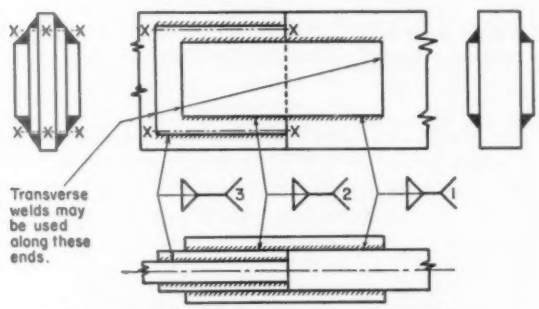
$$f_s = \frac{P}{1.414LS} = \frac{0.707P}{LS}$$

When such a joint is subjected to tension forces tending to pull the plates apart, but without any tendency for bending at the joint, the stress due to the direct tension is computed in the same manner. If a groove weld is used and the forces act as in Fig. 6(A), the effective area, A, which resists the direct tension is equal to the product of the length of the joint and the throat dimension of the groove weld, as would be expected. However, corner joints are nearly always subjected to loads that produce bending stresses, and other types of joints may also be subjected to such loads in some cases. In such cases the stresses due to the bending must be added to those produced by the direct tension or compression.

To determine the maximum permissible load on any joint, the terms of the applicable equation may be transposed. For example, equation (2) can be written,

$$P = 1.414f_sLS \qquad (3)$$

When the maximum allowable load, P, is to be found for a given permissible unit stress, the value given in the applicable design specifications for the unit stress, f_s, is substituted in equation (3) and it is solved to find P.



Effective area of welds ② shall equal that of welds ①. The length of welds 2 shall be sufficient to avoid overstressing the filler in shear along planes X-X.
Effective area of welds ③ shall at least equal that of welds ① and there shall be no overstress of the ends of welds ③ resulting from the eccentricity of the forces acting on the filler.

FIG. 7 PROPORTIONING SPLICES WITH FILLERS

Sometimes the dimensions and arrangements of parts joined by welds are such that the allowable unit stress for the base metal will be exceeded at some section before the welds become stressed to maximum permissible values. That is, the critical section lies in the base metal. In that case the maximum allowable load on the joint will be determined by the permissible stress for the base metal. For example, if the flange plate of the fillet welded T-joint (Figure 3-B) were relatively thin, it might tend to fail by shearing on two longitudinal planes along the toes of the fillet welds, perpendicular to the flange plate. In other words, the stem and the two fillet welds might simply tend to shear a chunk out of the middle of the flange plate, leaving this chunk attached to the fillet welds.

Figure 7 is an example of a case in which the lengths and sizes of fillet welds and splice material must be chose to prevent overstress in filler plates. As indicated, such filler plates are used sometimes where parts of different thicknesses are joined by a group of lap joints.

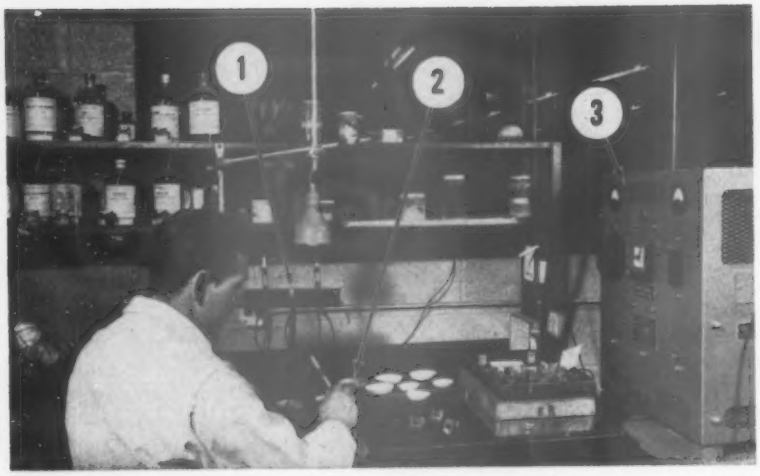
It might not be sufficient to simply make the effective areas the same for the three groups or pairs of fillet welds, designated at Nos. 1, 2 and 3 (each group being proportioned to resist the total load on the joint). The critical section might lie in the filler plate material. The shearing stress in the filler plates along the planes X-X must also be investigated. It might be necessary to increase the lengths of the outer splice plates on the left side of the joint, to provide for greater lengths of the No. 2 fillet welds. It also might be necessary to use a longer filler plate and longer No. 3 welds, thus increasing the effective shearing area of the filler plate along the planes X-X. However, if only the filler plate is extended, along the lengths of the No. 3 welds, and perhaps the strength of the No. 2 welds is supplemented by adding a transverse fillet weld across the end of the outer splice plate, there is still a possibility of failure in the filler plate. This could occur by tearing out a chunk of the filler plate, involving a combination of shearing along the toes of the No. 2 welds and tension along the toe of the added transverse weld. All such possible modes of failure may have to be considered in a special case of this kind; but under circumstances usually encountered in the design of fillet welded joints, any deficiency in the base metal area or thicknesses is likely to be obvious without demonstration by calculations.

In the design of fillet welded joints and connections, the sizes and lengths of fillet welds are most frequently determined solely upon the basis of strength requirements. However, specifications should include other requirements that must be met, such as the minimum size of fillet welds that may be used on any particular thickness of base metal.

One objective of avoiding the use of small sizes of fillet welds on relatively thick material is to prevent a very rapid rate of cooling of the deposited metal, which would result in excessive hardness and might cause cracking.

Requirements for minimum sizes and increment lengths of fillet welds are based also upon considerations for proper transfer of stress. Similar requirements are imposed in riveted work for minimum sizes of rivets for various thicknesses of material. • •

NEXT MONTH: A discussion of residual stresses and sample problems which explain how to figure the maximum allowable loads that can be carried by typical welded joints and assemblies.



OPERATOR PLATES aluminum surface (2) using current from rectifier power source (3). Spare styluses permit quick change over (1).

Plating Speeds Aluminum Soldering

by **WILLIAM J. ROSS,** *methods engineer, F & R Machine Works, Inc.*

IN BRIEF: Brush plating covers aluminum with an easy-to-solder nickel surface.

MICROWAVE EQUIPMENT is built to high standards. Even a tiny scratch on the flange face of a waveguide is a critical defect. To avoid rejects and to pass inspection at F & R Machine Works, Inc., in Long Island City, New York, we use selective plating in our finishing department.

This process was developed by Dalic Metachemical, Ltd. It can be used for soldering, brazing and plating. The process deposits one metal on another as in ordinary bath electroplating, but it is applied differently.

Makes soldering easy: Within the first year the equipment paid for itself. But before that we found another use for it. A new waveguide had to have a tin-framed glass window fastened in a recessed aluminum flange. Cement wouldn't work because the window had to withstand 20 psi pressure *from the inside* of the guide. We had to solder. But how do you solder on aluminum?

With selective plating, it's simple. You deposit a layer of alkaline nickel on the flange recess. Then you have only to solder to nickel. That's easy. In bath plating you cannot deposit a coat of nickel without extensive masking and stripping. You avoid all that when you use a stylus. First, swab some etching solution over the flange. Then electroclean. With the rectifier set for 10 volts, you can plate 0.0002 inch of nickel on the recess in less than a minute. Total time for the job: About three minutes.

Current flow during this operation is about 1.5 amperes. A circuit breaker in the rectifier completely protects the operator and equipment by cutting off power in less than a cycle (1/120 sec) in case of overload. The equipment can be started again by simply resetting the switch.

After the tin-framed glass is attached, we lap off the excess solder and nickel. The part is rinsed and is ready for shipment.

This process avoids tanks and volumes of plating solution by bringing the solution to the work. The anode is cotton-wrapped carbon stylus. The cathode is the work itself. The current comes from a rectifier with operating voltages from 4 to 16 volts. The plater dips the stylus in the plating solution. Then he rubs the charged swab lightly over the part. You can see a layer of metal plate almost immediately. The deposit's thickness increases directly with time.

It plates about one mil a minute (it varies with the metal being plated) over an area the size of the anode pad. The plating is less porous, denser than immersion plating. Selective plating will work to tolerances as close as —0.00005 in.

Cuts handling time 80%: We first used selective plating to cut the cost of reclaiming rejected waveguides. Of brass or bronze, the waveguides go through an acid bright dip and two plating immersions after machining. A flash deposit of copper is followed by a 0.0002-inch layer of either silver or nickel, depending on the waveguide. The outside, except for the plated flange faces, we then paint for protection.

When an unprotected flange was scratched or the plating peeled, we used to have to strip the entire component. Then we'd replate and repaint. This wasted a half an hour.

With selective plating, however, we can treat only the damanged flange face. The flange surface is hand smoothed with No. 600 emery cloth. Then we etch it, electroclean it, and plate it with 0.0002 inch of nickel or silver. By adding 5 to 10 percent cobalt solution to the alkaline nickel solution we get a much higher luster. ad to men on the move . . . . . .

Plating is extremely fast. For current densities (1200 and 700 amp per sq. ft. for nickel and silver, respectively) are about 25 times higher than those of standard immersion processes. We can change styluses and electrolytes quickly and easily whenever we want to plate a different metal. It takes us less than 5 minutes to reclaim a part.

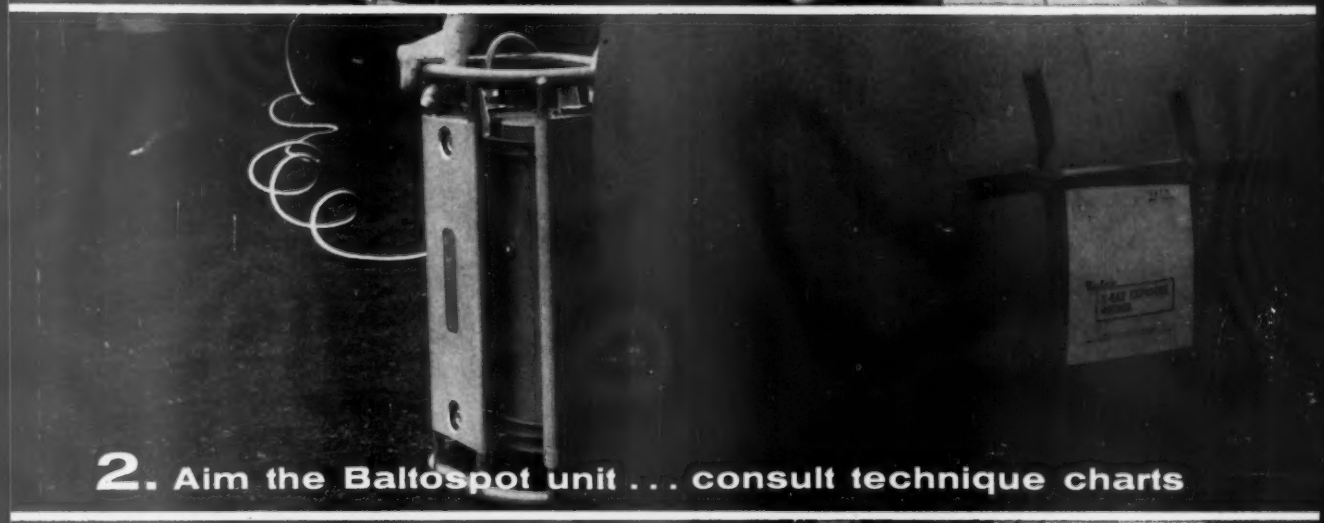
We keep a whole entire selective plating installation (styluses, special rectifier, various etching, cleaning, and plating solution) in a corner of our finshing department. The equipment takes up little room. It's handy for production applications as well as repairs and maintenance.

Although we have incorporated two major applications in the plant so far, we know there are many other practical uses for this process. • •

FACTS AT YOUR FINGERTIPS: *If you want copies of the catalogs featured in this issue or if you want information on new products introduced, just circle the appropriate number on the bound-in Reader Service Card. We'll do the rest.*

For More Information Circle No. 74 on Reader Service Card. →

1. Attach the film holder



2. Aim the Baltospot unit . . . consult technique charts

3. Set the controls . . . press the button!

YOU'VE JUST MADE A WELD X-RAY!

Taking repetitive or field X-rays is a 1-2-3 operation with this Baltospot portable unit—can be learned in less than a day. You simply carry the unit to the job, X-ray the weld, and develop the film—all in a matter of minutes.

And don't forget—X-ray weld inspection is a real cost-cutter, too (77% savings on inspection were recently reported by a prominent tank fabricator).

For the whole story, contact your nearby Westinghouse X-ray sales representative. Or write: Westinghouse Electric Corporation, X-ray Department, 2519 Wilkens Avenue, Baltimore, Maryland. J-08378

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RWMA Class #3, Tipaloy #200
and other RWMA classes of alloys to fit your needs.

It is unwise to pay too much, but it is worse to pay too little!

Use TIPALOY and get 30% to 100% more performance for your money than you are now getting.

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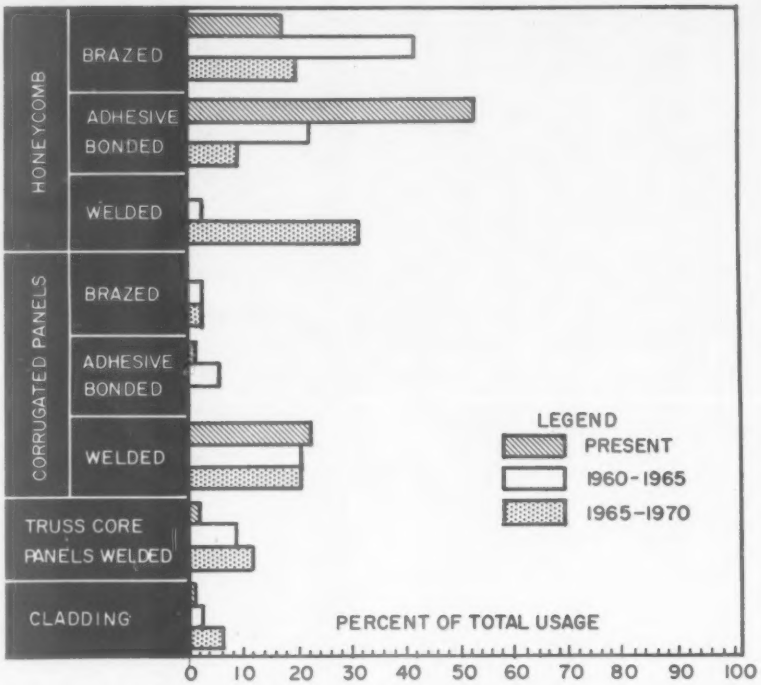
AIRCRAFT INDUSTRY FORECAST *continued from page 43*



TOTAL USAGE of composite material structures for air vehicles is shown for present and is predicted for 1960-1965 and 1965-1970.

sufficient capacity to join materials like titanium and PH steel in thicknesses from .005- to .125-inches.

■ Clamping fixtures and positioners must be developed to get positive holding and stabilizing of comparatively delicate parts. They will also be required for more uniform speed and better part alignment, particularly of thin sheets in thicknesses from 0.005 to 0.020-inches.

Lightweight holding devices must be developed for ultrasonic welding; semi-portable inert-gas equipment will be needed for joining major components during final assembly stages.

Portable equipment will also be needed for edge preparation.

New fixture materials must be developed for chilling, clamping and locating fixtures used in butt welding sheets. Improved ceramic materials may be adaptable for such fixtures.

■ Controlled atmospheric conditions may be achieved through further development of weld zone-purification processes, such as tungsten inert gas welding.

Molecular bombardment or electron welding is a distinct possibility. Pressure welding and plasma jet might also offer promise. Electron gun welding in a vacuum on materials which combine readily with oxygen and nitrogen might yield highest quality welds.

Improved ultrasonic welding techniques are also needed. For joining honeycomb panels, ultrasonic welding might be adapted with the welding medium being powdered or granular and attracted to the weld joints magnetically to allow welding at a low temperature.

Large weldments—both restrained and unrestrained and welded before and after heat treatments—should be investigated along with localized heat treating during final assembly.

BRAZING:

Brazing requirements will include (1) means of controlling atmospheric contamination, (2) improved facilities for brazing new materials and larger units and (3) closer control of manufacturing variables.

■ Improvements are necessary in controlling optimum atmosphere prior to and during the brazing cycle. Further development will be needed in evaluating "stabilizers" to control node flow and defusion.

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ACORN

BENDING BLOCKS or WELDING PLATENS

Semi-steel Blocks for layout, welding assembly work, etc., with machined working surfaces; also tools and accessories, including a full line of clamps, drift pins and dogging devices. Standard and special stands can be supplied. A 4-unit set-up, joined and mounted on stands, is shown above.

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Wolverine Clamps are available in a variety of styles, sizes and mountings.

Write for Bulletin 59-C

WOLVERINE TOOL CO.
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Early efforts must be directed towards developing alloys have low initial melt and high remelt points. Brazing development will continue to minimize solubility erosion.

An investigation should be made of the feasibility of a jointly sponsored "space room" capable of providing a total inert-gas environment meeting the brazing requirements of the participating manufacturers.

■ Brazing fixtures for large-area parts and for panels capable of continued operation through 2750°F must be developed. Tool materials for these fixtures and new types of brazing furnaces will be necessary. The new-type furnaces will be used to braze ceramics, cermets, glass and refractory metals.

Facilities development must progress toward heating only the assembly to brazing temperature with minimum tooling and furnace brick heat. This will permit development of techniques for quick heating of assemblies while minimizing contamination and solubility erosion.

Fixtures incorporating rigid support, close tolerances, uniform heating and minimal deformation during heating cycles are needed.

■ Techniques and controls must also be developed to permit "localized" brazing of large final-assembly panels. Development of portable brazing units will be required for this purpose.

Improved techniques in preparing detail parts for fit-up are required to reduce the amount of filler alloy required. • •

O. S. Walker Acquires Buck Manufacturing Co.

WORCESTER, MASS: The acquisition of the principal assets and all patent rights of Buck Manufacturing Co., San Jose, California, has been announced by John Englested, president of O. S. Walker Company, designers and manufacturers of magnetic chucks. Buck manufactures "Bux" portable magnetic drill presses and related products.

Richard F. Carey, formerly Buck's sales manager, has been appointed general manager and secretary of the new corporation which will operate under the same name and do business from its present location in San Jose.

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For Heating or Cutting

from HARRIS "Portable-Forge" Torch No. K-43

the HARRIS K-43 does the job QUICKER

A concrete example: A large manufacturer is required to heat (expand) the 7" tie rods on each corner of a large press. Using the oxy-acetylene flame and 2 of the largest torches possible, 2 operators required 2½ hours (total 5 hours); whereas 1 operator, using the Harris Super-Heating K-43 torch did all 4 rods in just 17 minutes.

Harris engineers have designed this equipment for use in low cost cutting and heating operations with less danger of backfire or flashback.

HARRIS OFFERS THESE ADVANTAGES

- 90% Reduction in time
- Heats 4" steel shaft red hot in 5 minutes (With 3-H tip)
- Wide range of flame adjustments
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COMPLETE PROPANE CUTTING AND HEATING UNIT

K-43 Super-Heating Torch with cutting attachment — The result of scientific research on the part of Harris Engineers to produce a torch specifically for use with propane gas.

2290-H Series Heating Tips (1-H to 5-H inclusive)
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6290-NFF Series Cutting Tips (0-NFF to 4-NFF inclusive)
92-25C-P "Multi-Stage" Propane Regulator
93-SC "Multi-Stage" Oxygen Regulator

HARRIS

LITERALLY, A "PORTABLE-FORGE."

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For More Information Circle No. 33 on Reader Service Card.

HERE'S AN IDEA

TELEVISION CAMERA focused on welding head transmits image of welding operation to monitor screen. Image guides operator in controlling carriage speed and lateral pipe movement.

Closed-Circuit Television Helps Guide Automatic Welding Head

IN BRIEF: U.S. Steel's National Tube Division uses television to get high quality welds on inside diameter of 40-foot pipe.

A TELEVISION CAMERA watches the welding head at all four inside diameter pipe welding stations at U. S. Steel's National Tube Division.

The inside seam welding is done at National Tube's National Works, McKeesport, Pa., by mounting a submerged arc welding unit on a 45-foot boom. Forty-foot lengths of steel pipe are moved into the boom. The welding unit remains stationary.

A small television camera focused on the welding head is also mounted on the boom. The pipe carriage moves the pipe forward. The imag of the welding head operating inside the pipe is transmitted to a monitor screen located at the operator's control console. Carriage speed and lateral pipe movement are also controlled from this console.

The operator's guide is a three-pronged pointer within the camera's field of vision. The center prong is lined up with the welding head. Outside prongs are lined up with white lines placed exactly 2½-inches on each side of the center seam.

As the operator draws the pipe carriage over the welding head, he maintains complete control of the welding operation by keeping the three prongs riding their respective lines.

The television "eye" is used on steel pipe ranging from 24- to 36-inches OD with wall thicknesses from .250- to .656-inches.

Welding speed varies with wall thickness. For instance, pipe with .375-inch wall is welded at 60-65 ipm.

National Tube uses tandem submerged arc welding units with two 5/32-inch diameter wires. The machine draws 940 amperes at 28 volts on the lead of the first wire and 600 amps at 32 volts on the trailing wire. • •

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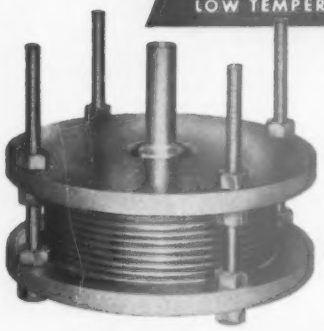
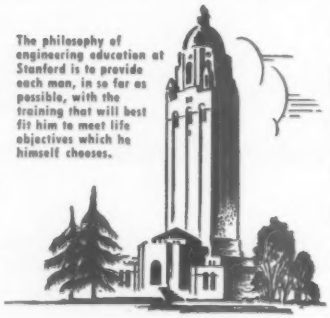


STANFORD UNIVERSITY


The philosophy of engineering education at Stanford is to provide each man, in so far as possible, with the training that will best fit him to meet life objectives which he himself chooses.

This vacuum bellows is part of the liquid target assembly located on the business end of the linear accelerator developed by Stanford University. The bellows is .0106" brass, joined to half-inch-thick Muntz metal flanges. This is a difficult brazing job at best—being done successfully at Stanford University, using Silvaloy 45. Heating is by torch and carbon block. Needless to say, despite the technical difficulties of this job, only a perfect, strong vacuum-tight joint is acceptable.

For this reason, technicians at Stanford University use Silvaloy 45 and Deoxo Flux for their reliable quality and consistent performance.

Silvaloy brazing alloys and fluxes are helping to speed production, lower costs and improve brazing results in many fields. Call your nearest Silvaloy distributor for information or technical assistance.

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For More Information Circle No. 9 on Reader Service Card.

REFERENCE DATA

catalogs, handbooks, manuals

A PORTABLE oxygen cutting machine manufactured by Messer Cutting Machines, Inc. is the subject of illustrated literature. Advantages, specifications and procedures are given for the Quicky cutter, described as the "featherweight cutting machine with heavyweight capacity." **For More Information Circle No. 44 on Reader Service Card.**

OPERATING FEATURES of the new Zephyr weld shaver for cutting and finishing weld beads to within plus .001" of surface plane are detailed in Catalog 17 issued by Zephyr Mfg. Co., Inc. Models for finishing soft alloy weldments, titanium, stainless steel and hard alloy beads are described. **For More Information Circle No. 79 on Reader Service Card.**

WELDING AIDS are the subject of full-information catalog published by Thermacote Company. Among the featured products are "Triple-Duty" cover lenses and "Thermo" spiral tip cleaners. **For More Information Circle No. 62 on Reader Service Card.**

IF BRAZING is your business, technical information-packed booklet prepared by United Wire and Supply Corp. will help you considerably. It discusses the advantages, applications, composition and physical properties for Phoson and Sil-bond alloys and tells how they are packaged and what specifications they meet. **For More Information Circle No. 65 on Reader Service Card.**

DEPRESSED CENTER grinding wheels (reinforced resinoid bonded) are featured in a 12-page illustrated catalog published by Simonds Abrasive Company. In addition, resinoid-bonded straight, cup, and mounted wheels are described. Specifications, ordering and operating information are included. **For More Information Circle No. 57 on Reader Service Card.**

345-PAGE HANDBOOK full of metal- and ceramic flame-spraying "how to" information has been published by Metallizing Engineering Co., Inc. Profusely illustrated with pictures, diagrams, charts, and tabulated engineering data, the new text is an invaluable reference for product design, materials engineering, machine maintenance, and corrosion protection of iron and steel structures and exposed equipment. **For More Information Circle 85 on Reader Service Card.**

HIGH-PURITY brazing alloys for copper, bronze or brass are described in a new 8-page booklet prepared by Alloy Specialties Company. Complete specifications and cooling charts are given on standard alloy compositions for non-ferrous brazing and for silver solders for ferrous and non-ferrous metals. **For More Information Circle No. 86 on Reader Service Card.**

RADIOGRAPHIC INSPECTION OF WELDED PIPELINES is comprehensive booklet published by Gevaert Company of America, Inc. It contains data on techniques for inspection of welded joints and a data table for using the company's Structurix Industrial X-ray films. **For More Information Circle No. 87 on Reader Service Card.**

GAUGELESS REGULATORS, a new development of the Linde Company, Division of Union Carbide Corp., are described in an illustrated data sheet just off the press. Complete specifications and operating data are given for the Oxweld R-550 Regulators, designed for use with oxygen, acetylene or propane, with the danger of gauge breakage eliminated. **For More Information Circle No. 88 on Reader Service Card.**

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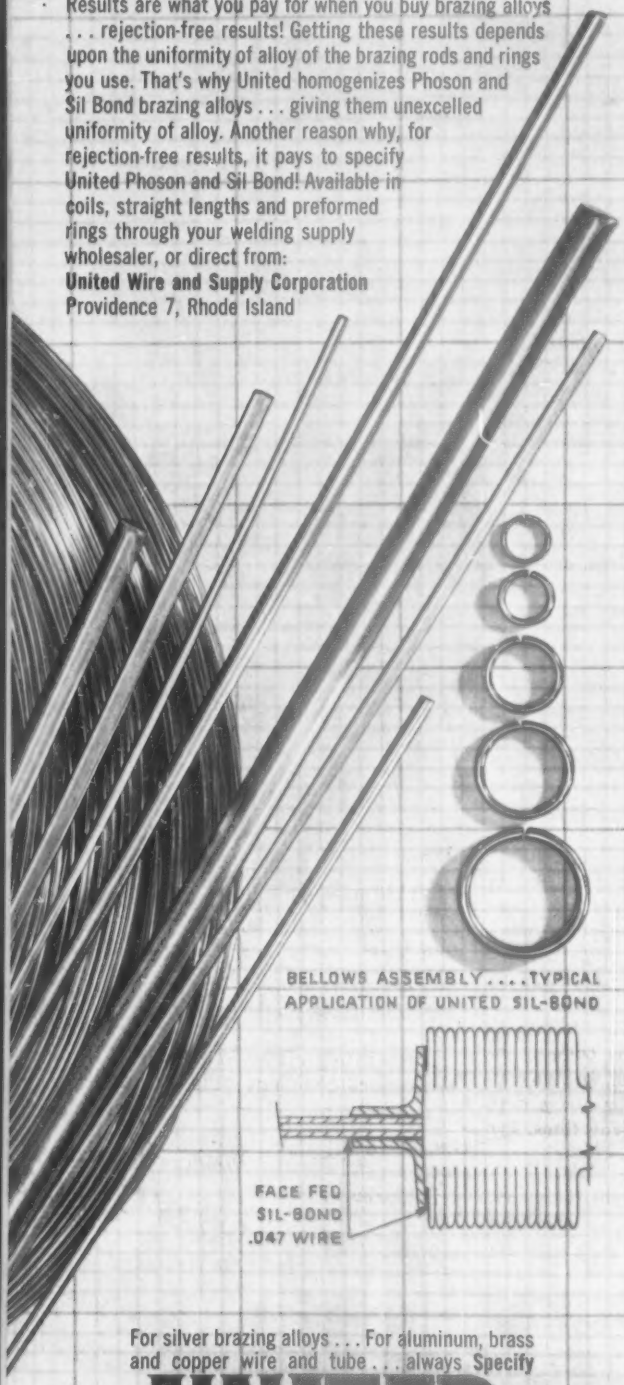

For silver brazing alloys . . . For aluminum, brass and copper wire and tube . . . always Specify

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USEFUL LITERATURE *continued*

WANT PRODUCTIVITY on tough snagging and grinding operations? Literature from Vee-Arc Corporation will tell you how to get it with their 2 HP portable grinder. It describes fully how the powerful but light-weight grinder does more work with less operator fatigue . . . how it can be plugged into the nearest 120 v. AC power outlet, ready to hog off metal with its 9″ disc wheel . . . and how it is lubricated for life and tamper-proof sealed.

Circle No. 67 on Reader Service Card.

TOGGLE CLAMP FEATURES are outlined in Bulletin 59-C just offered by the Wolverine Tool Co. Specifications and applications for the variety of sizes, styles and mountings available are thoroughly treated. Valuable information is given on how speedy-clamping can save considerable money.

Circle No. 75 on Reader Service Card.

ELECTRIC TOOLS—drills, saws, grinders, hammers, screw drivers, nut runners, sanders and polishers—are described in 12-page condensed Catalog G8 available from Milwaukee Electric Tool Corporation. A brief description, specifications and prices are given for each heavy-duty tool. A list of authorized tool repair service stations throughout the United States and Canada is included.

Circle No. 47 on Reader Service Card.

GAS MANIFOLD catalog containing 24 pages on capacities, dimensions, arrangement and advantages of manifolding is available from Air Reduction Sales Company. The new, illustrated edition includes information on recently developed manifolds for CO2, and liquid oxygen, argon and nitrogen, as well as current data on the standard manifolds for gaseous oxygen, argon, nitrogen, helium, acetylene, hydrogen and propane.

Circle No. 96 on Reader Service Card.

ALUMINUM COATED steel wires and wire products—core, strand, ground, tie, messenger, telephone, and barbed wires, and chain link fabric—are described in a 6-page folder (DH-537B). Issued by the Page Steel and Wire Div., American Chain & Cable Co., folder lists properties and applications of the wire products which combine the strength of steel and the corrosion resistance of aluminum.

Circle No. 97 on Reader Service Card.

A FAMOUS STAR of motion pictures and television, John Carradine, helps tell the story of automatic and semiautomatic CO_2—shielded welding processes in a new brochure, "Who's Who in CO_2", prepared by A. O. Smith Corp. The unique, 16-page illustrated brochure completely details the company's three CO_2 processes: C-OMANUAL, a semi-automatic hand-gun process; C-OMATIC, a fully automatic process, and C-OMANUAL Button Welder, a semi-automatic hand-gun process.

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"FAST, EASY and safe steel hardening compound, Hard-N-Tuff, is guaranteed to produce 60 RC even on low carbon steels" says literature from Hard-N-Tuff Corporation. It goes on to tell what Hard-N-Tuff does and how it does it on cutting tools, impact tools and dies, machinery and jigs and replacement parts.

Circle No. 31 on Reader Service Card.

"PRODUCTION DATA SHEET NO. 22 . . . a guide to machine selection for spot welding" . . . is available from Thomson Electric Welder Company. Step-by-step instructions are given for using the tabulated machine selection guide by means of control and material groups charts.

Cirlce No. 98 on Reader Service Card.

PORTABLE FABRICATING Shlagromatic spacing drill is the subject of a 4-page, illustrated bulletin prepared by Shlagro Steel Products Corp. Literature tells how the structural steel and plate fabricating tool locates and drills holes without marking or center punching.

Circle No. 99 on Reader Service Card.

UNIVERSAL SHEARING and forming machines are the subject of a 4-page illustrated brochure available from American Pullmax Co., Inc. Literature describes machine models for every size shop and purpose, their capacities and applications. How 12 standard cutting and forming operations can be done with stock tools and accessories is explained. In addition, the brochure explains the availability of a 16mm sound film and a mobile demonstration unit.

Circle No. 100 on Reader Service Card.

"WHY WASTE WATER?" is the question posed in literature available from Van Vooren Products. Literature describing their water-saving "Water Mizer" explains how single valve method or "Hi-Lo" dual flow method can pay for itself in less than one year when applied to large projection welders, seam welders and multi-stage air compressors.

Circle No. 101 on Reader Service Card.

A NEW copyrighted manual describing the use of welding carbon products (rods, plates and paste) has been prepared by Arcair Company. The completely illustrated book shows basic applications of these products to today's welding jobs. It explains how the use of carbon plate, rod, and paste eliminates the need for many jigs and fixtures, especially on small jobs.

Circle No. 102 on Reader Service Card.

A SHAPE CUTTING machine designed to cut an unlimited variety of shapes either as a stationary or portable machine is thoroughly described in a brochure available from Ohmstede Machine Works. Literature lists specifications, describes conveniently located controls, spindle and magnetic tracing devices, and explains three different methods for making templates.

Circle No. 103 on Reader Service Card.

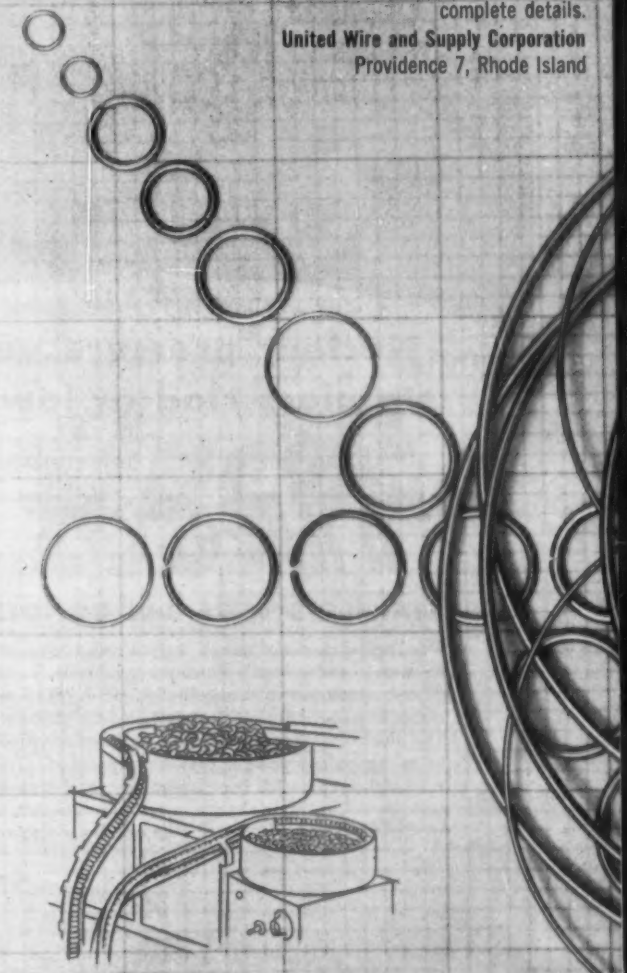
For More Information Circle No. 66 on Reader Service Card.→

AUTOMATION

Reason why it pays to Auto-Braze with **Phoson** and **Sil-Bond** Brazing Rings

Automated brazing has mushroomed into prominence as a profitable production technique for fast, dependable metal joining. And, it's easily adaptable to most manufacturing processes! United's precision brazing rings are manufactured for automation! Teamed with United's engineering know-how, Phoson & Sil-Bond alloys continue to boost the profit picture for many manufacturing concerns. If fastening costs are one of your problems, why not consult your United Brazing Product distributor . . . or write direct giving complete details.

United Wire and Supply Corporation
Providence 7, Rhode Island



TYPICAL AUTOBRAZING EXAMPLE . . . PRELOADING PHOSON RINGS ON COPPER U-BENDS

For aluminum, brass and copper wire and tube
For silver brazing alloys . . . always **Specify**

UNITED

Job Report Courtesy of
Alco Products, Inc., Schenectady, N. Y.

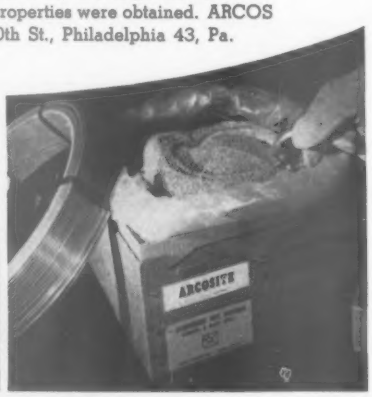
Nuclear pressure vessel stainless clad at low cost

USE ARCOS

STAINLESS WIRE and BONDED FLUX

This "barrel" is one of several that comprise a nuclear pressurizer to operate under highly corrosive conditions. To reduce costs, Alco Products forged the shell of ASME A-336, 2—4 inch thick manganese molybdenum steel and clad the inside with stainless. The illustration shows the second pass overlay which was made by submerged arc using Arcos Chromenar K-LC (Type 308) bare wire and Arcosite S4 flux. Lower cost, and high corrosion resistance with optimum physical properties were obtained. ARCOS CORPORATION, 1500 South 50th St., Philadelphia 43, Pa.

Bare Wire



Arcosite Flux

For More Information Circle No. 11 on Reader Service Card.

PORTABLE SANDBLAST GUN is described and illustrated in a bulletin available from Lindberg Products Company. This sandblast gun is said to be rugged and efficient for cleaning metal surfaces or small parts before and after welding.

Circle No. 41 on Reader Service Card.

CYLINDER TRUCKS made by Welded Truck and Specialty Company are the subject of a bulletin that describes the advantages and uses of five different models available for one or two cylinders.

Circle No. 89 on Reader Service Card.

WELDERS' CLAMPS are the subject of a catalog available from The Cincinnati Tool Company. It lists a complete line of spring, standard carriage, forged steel, heavy duty, deep reach, quick acting clamps and describes clamp fixtures for ½- and ¾-inch pipe.

Circle No. 90 on Reader Service Card.

WELDING CABLES made by Belden Manufacturing Company are the subject of a catalog. Described and illustrated is their O.T.R. rubber-jacketed cable, neoprene-jacketed cable, HVF vinyl plastic-jacketed cables, plus rubber-jacketed welder power supply cords.

Circle No. 91 on Reader Service Card.

ELECTRODE HOLDERS are the subject of a catalog offered by Duro Engineering Company. The catalog gives complete information on the Duro line, including the standard and the new "Durogon" tong-type holder.

Circle No. 25 on Reader Service Card.

11-13½ MANGANESE-NICKEL- Steel welding electrodes for build-up and strength are the subject of a descriptive booklet available from the Ford Steel Company. The booklet also lists a complete line of products: plate, applicator bars, cast dipper tooth and repointers.

Circle No. 92 on Reader Service Card.

STEEL LIFTING CLAMPS made by J. C. Renfroe & Sons, Inc. are the subject described in an illustrated new catalog. Catalog gives infor-

mation on the company's precision-built "Bulldog" line. Clamp capacities are from ½-ton to 20-tons with a 5 to 1 safety factor.

Circle No. 52 on Reader Service Card.

FUME COLLECTING SYSTEM made by Ruemelin Manufacturing Company is featured in a comprehensive bulletin. Design details and operating specifications are given for using the fume collector mechanism in welding shops.

Circle No. 54 on Reader Service Card.

GAS CONTROL UNIT is the subject of a bulletin available from Smith Welding Equipment Corporation. The push button control is said to save up to 10% oxygen costs, and up to 30% fuel gas costs. The bulletin explains the operating characteristics and uses.

Circle No. 93 on Reader Service Card.

GAS WELDING AND CUTTING equipment marketed by Dockson Corporation is the subject of a catalog on their complete line. Described and illustrated are gas welding torches, welding outfits, goggles, regulators, face shields, fittings, helmets, fluxes and accessories.

Circle No. 24 on Reader Service Card.

SEMI-AUTOMATIC OPEN ARC wires are the subject of an engineering data sheet available from Alloy Rods Co. The data sheet gives the description and applications for high strength welds on manganese and carbon steels, using Wear-O-Matic WH. Physical and chemical properties and welding data are given.

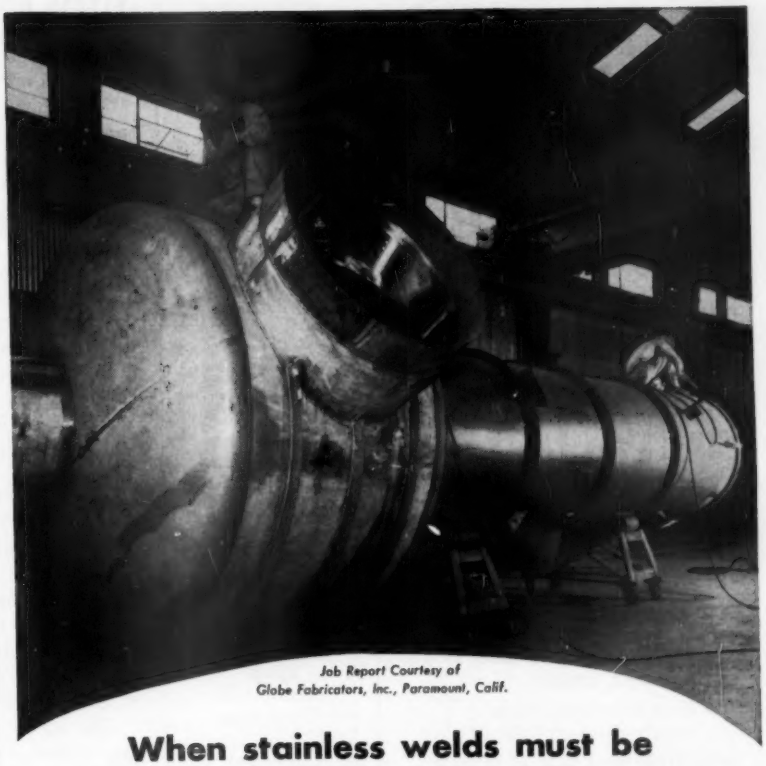
Circle No. 94 on Reader Service Card.

A VARIETY OF TEMPERATURE- indicating crayons are described and illustrated in a 6-page folder from Tempil Corporation. Catalog No. 589 lists crayons, pellets and liquid temperature indicators.

Circle No. 95 on Reader Service Card.

FREE FLUX SAMPLES are available from Krembs & Company, manufacturer of 25 different welding, brazing and soldering fluxes. Write for yours on company letterhead. Use Reader Service Card for literature.

Circle No. 38 on Reader Service Card.



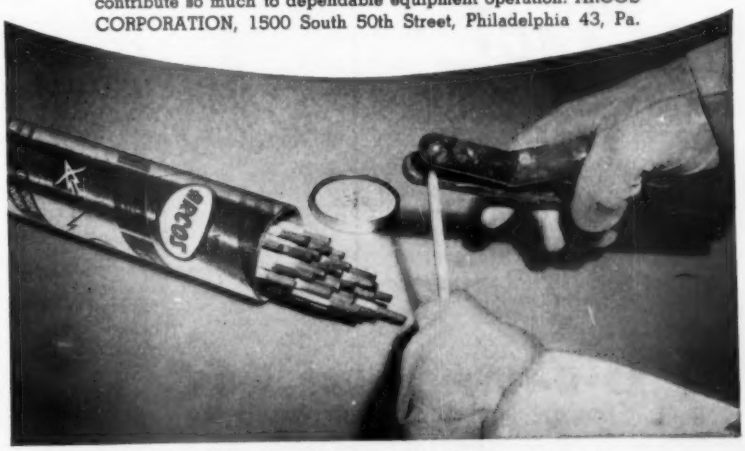
Job Report Courtesy of Globe Fabricators, Inc., Paramount, Calif.

When stainless welds must be highly sanitary and corrosion resistant

WELD WITH ARCOS

STAINLESS ELECTRODES

Welded citrus fruit processing equipment such as this must *resist corrosion*, must *not contaminate* the food and must be *strong*. Type 304 stainless, used for all food contacting sections, was welded with Arcos Chromend K (Type 308) electrodes. For welding the non-stainless supporting members to stainless sections, Arcos Chromend HCN (Type 310) electrodes were used. Again, Arcos electrodes provided multiple benefits that cost so little and contribute so much to dependable equipment operation. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



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FOR

HARD SURFACING

USE

HARD-N-TUFF ®

The STEEL HARDENING COMPOUND that makes TOOLS and PARTS LAST 300% LONGER!

HARD-N-TUFF is used by leading firms in every industry for tough hard-surfacing problems because of these proven advantages:

- Works on any kind of steel, cast iron, or iron-base powdered metals.
- No special equipment required—treat tools in your own shop.
- Entire application takes only 5 to 10 minutes.
- Nitrides, carburizes and chromizes in one simple operation.
- Produces file-hard case with tough inner core.
- Makes mild steel outwear tool steel.
- Creates no distortion or change in dimensions.
- Safe—contains no caustic ingredients.

Prior to being treated with HARD-N-TUFF, this high-speed drill could make only one hole through chrome and nickel casting 17/32" thick, before being redressed. After HARD-N-TUFF treatment, this same high-carbon drill was used 20 times, without redressing, for the same job.

These untreated spur gears lasted only about 1 month before wearing out. Now the gears, after treatment with HARD-N-TUFF, last at least 6 months.

Write for FACT SHEET

that lists unlimited applications; shows how easy HARD-N-TUFF is to use; gives a partial list of firms now using HARD-N-TUFF to cut costs and increase production; complete price list and packaging details.

Chisel made from ordinary 1020-1/2" drillrod, hardened with HARD-N-TUFF, cut rust-locked nut with 2 hammer blows. Cutting edge was completely undamaged.

HARD-N-TUFF CORPORATION

DEPT. 6, BOX 275, HUNTINGTON, L.I., NEW YORK

For More Information Circle No. 31 on Reader Service Card.

STRESS RELIEVING *continued from page 53*

On welds not requiring radiographic inspection, standard rings are used.

All tubing joints are made with Vee-type bevels and no backing ring. These get a tungsten arc-inert gas root pass followed by metal arc welds. A consumable insert ring is used on stainless steel root passes.

Chrome-moly: Piping ranges in wall thickness from 1¼- to 2¼-inches. A steel containing 2- to 2½-percent chrome and .9- to 1.1-percent molybdenum is used for both piping and tubing. Another steel containing .85- to 1.2-percent chrome and .48- to .63-percent molybdenum is also used for piping and tubing.

A typical joint in a 10½-inch diameter pipe with a 1½-inch wall is made with a U-groove and a chill ring.

The joint is wrapped with asbestos before welding and the small diameter (No. 3) copper wires, which require no water cooling, are wrapped around the pipe. The 50 KW induction heating unit, with its 75hp motor, then takes over. When pipe has been preheated to a minimum of 400°F, asbestos covering and wires are separated so welding can start. A toggle switch is thrown on the control panel to demagnetize pipe before welding starts. If this were not done, arc blow would make welding difficult. Welding is done with an E90XX B3L electrode on 2¼-chrome and a E80XX B2L electrode on 1¼-chrome.

The 400°F preheat temperature is maintained during welding; thermocouples attached adjacent to the weld automatically control the unit. When welding has been completed, the coil and asbestos are moved back over the joint and controlled heating starts. The joint is heated to 1375°F (plus or minus 25°F) and held one hour per inch of thickness. The joint is then permitted to cool to 600°F maximum under its asbestos insulation.

Stainless steel: Welded joints are made in Type 316 pipe with wall thicknesses ranging from ¾- to 3½-inches. After welding, temperature is raised at a controlled rate to 1850-1900°F and held there one hour per inch of thickness (minimum time is one hour). Coils are removed and joints are air-cooled as quickly as possible to prevent carbide precipitation.

The induction heating unit's strip chart which records all temperatures is checked closely during and after stress relieving operations. The chart is a permanent record of every operation. • •

BRAZING MOLYBDENUM *continued from page 48*

one of the few elements whose solubility in molybdenum was appreciable and still possessed a fairly low melting point (2830°F). Brazing was also done with iron, copper, silver, and nickel-based alloys to provide some benchmark information on joint strengths and micro-structures. All brazing was done in a hydrogen atmosphere furnace because this is the principal method of brazing actual jet engine components.

In addition to evaluating brazing alloy applied directly to molybdenum, experiments were performed on brazing chromium-plated molybdenum. Chromium does not form intermetallics with molybdenum, and

acts as a diffusion barrier to intermetallic-forming elements in brazing alloys.

A series of shear tests were performed on simple lap joints brazed in Mo-½ Ti sheet with a wide variety of brazing materials. The test specimens were designed with "ears" for initial tack welding. These ears were removed during machining prior to testing. This prevented testing of the zone recrystallized in welding. Testing of specimens at room temperature, 700°F and 1000°F was done in air with no special protection for the molybdenum. Tests at 1500°F were performed in vacuo.

Room temperature tests showed the iron base filler materials to be the weakest, probably because of their brittleness. The brittle Ni-Si and Ni-Cr-Si alloys were also quite weak. Pure copper and the palladium-copper alloy were the strongest filler materials at room temperature. Palladium-copper was probably the most desirable of these two materials, as embrittlement of the Mo-½ Ti by pure copper resulted in parent metal failures at the same stress level where shear failures occurred with Pd-Cu. Fairly high room temperature strength was also obtained with the silver—5% copper alloy. The three filler materials that showed highest room temperature strength were all ductile alloys. Only one, however (the Pd-Cu alloy), was a high melting point material suitable for elevated temperature service.

The room temperature results showed that palladium alloys did indeed possess promise for molybdenum brazing. So lap joints for elevated temperature tests were prepared with two Pd-Cu alloys, plus a Pd-Ni and a Pd-Al alloy. Results of testing these at 1500°F showed the Pd-40 Ni alloy strongest and the Pd-35 Cu alloy weakest.

Butt joints were also made in Mo-½ Ti with a Pd-30 Cu alloy. These were tested at 1500°F, 1800°F, and 2000°F in vacuo. Though lower than hoped for, the 2000°F butt-joint strength of approximately 7000 psi was encouraging.

Our work is still in progress.

Definitely encouraging results have been obtained with palladium-based alloys. I believe that alloys based on this precious metal offer the best filler material solution to the problem of brazing molybdenum for high temperature service.

Another reasonably good solution is the use of nickel-base high temperature filler materials applied over a chromium plate diffusion barrier. This was the approach used in the molybdenum turbine bucket work done in our laboratory. Good results in 2000°F service were obtained when this method was used for brazing claddings onto molybdenum. • •

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2. *Johnston, J. H. et al, Joining of Molybdenum, Welding Journal, September* 1954, *pp.* 449-448*s*
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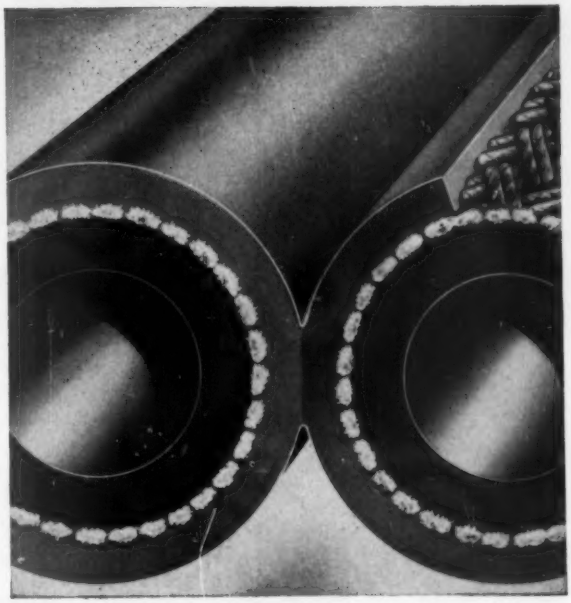

TWIN-WELD . . .
THE
NON-KINKING
HOSE!

Because it's molded in *straight* sections by the exclusive Hewitt-Robins platen press process, Twin-Weld hose eliminates troublesome kinking and curling. Thus it's safer, neater, easier handling.

Twin-Weld gives these extra advantages, too:

NON-POROUS. Increases welding efficiency . . . promotes safety.

NON-SNARLING. Continuously joined . . . yet easily separable if desired.

LONGER LASTING. Flame-resistant neoprene cover adds greatly to service life.

Twin-Weld is preferred by the great majority of experienced welders. For further information or service, consult your local H-R representative, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 9-44.

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INDUSTRIAL HOSE . . . VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

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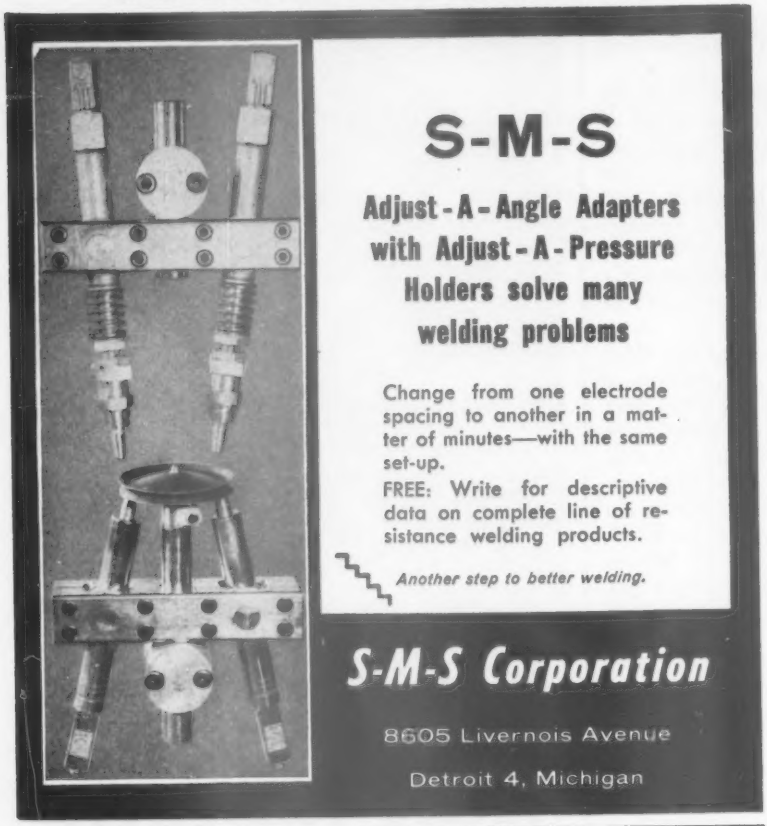

S-M-S

Adjust-A-Angle Adapters with Adjust-A-Pressure Holders solve many welding problems

Change from one electrode spacing to another in a matter of minutes—with the same set-up.

FREE: Write for descriptive data on complete line of resistance welding products.

Another step to better welding.

S-M-S Corporation

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in the familiar green drum

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EMPIRE STATE BLDG., NEW YORK 1, NEW YORK

PLANTS: Keokuk, Iowa; Pryor, Oklahoma; and Shawinigan Falls, Quebec, Canada

For More Information Circle No. 56 on Reader Service Card.

WELDING PLATENS

continued from page 50

the replacement. His rough sketch, showing pipe material and size, developed length, location and radius of bends, is all his certified welding operators need.

They quickly drop three tapered drift pins in the square holes of the 5-ft. platen to hold the pipe, then a round post to bend the pipe around. One operator heats the pipe with an oxyacetylene torch, the other pulls on the long end (sometimes adding another length of pipe for better leverage) until the bend is made.

As soon as the new pipe sections are welded into place, the power generating system goes back to work. The danger of an outage is past.

All pipe joints at Eastlake, except small water and oil lines, are welded. These include diameters up to 2 inches in carbon, chrome-moly, and stainless steel. These materials in a range of wall thicknesses help resist the high temperature (1,050°F) and high pressures (1,800 to 2,400 lb.) at which the system operates.

C.E.I.'s welding platen is pressed into service for other important jobs. For example, the conversion of the injection water piping. Twenty bends had to be made in about 100 ft. of extra heavy chrome-moly pipe. On the platen, these bends were made quickly and accurately.

And there is always hardsurfacing and buildup work to do. A typical job is the arc welding buildup of worn stainless impellers. Arm clamps, a standard welding platen accessory, let an impeller be surfaced without distortion. The clamps are not removed until the part is cool.

Republic Structural Iron Works of Cleveland has 24 welding platens. They specialize in heavy plate and structural fabrication, have to cope with severe welding and bending stresses.

Most of Republic's platens are used in bolted groups of five. Others are used in larger groupings to handle large weldments such as press-brake frames and bases. One or two are reserved for portable use. One day they'll be used to check and hammer-form parts in the press room. Another time you might find them serving as a jig in the stair shop.

Two jobs typify Republic's use of welding platens. One was the head of a plastic molding press. Due to

heavy overloading, it cracked.

To repair the crack without rigid clamping would distort the head so much it would have to be replaced. This wasn't necessary.

They bolted the head solidly to a welding platen through heavy guide rod bushings in each of the four corners. Nothing could move. The crack was grooved out with a carbon-arc-compressed-air torch and welded. After cooling they removed the bolts and the costly head was ready to re-install on the press.

The other Republic job made use of welding platens on a long term basis as assembly and tacking jigs for aluminum diesel engine bases. They made stops and squaring arms, bolted them to the platens. The 1¾- to 2-inch thick aluminum parts were clamped to the squaring arms and tack welding. Base after base came off the jigs within specified tolerances, ready for mounting on positioner fixtures for finish welding. • •

A.W.S. Again Holds Annual Fall Meeting

NEW YORK CITY: The American Welding Society has resumed its practice of holding a national meeting in the Fall of each year, according to Fred L. Plummer, national secretary.

This year's meeting will take place in Detroit, Michigan, Monday through Thursday, September 28 through October 1. The Sheraton-Cadillac Hotel in Detroit will be the Society's Headquarters hotel where the various technical sessions and social activities will take place.

Activities scheduled include 48 technical papers, a banquet, meetings, plant tours and a complete ladies' program.

Eutectic Opens Warehouse-Service Center

CHICAGO, ILLINOIS: Eutectic Welding Alloys Corp. has announced the opening of a new, expanded warehouse-service center here at 4353 South Kedzie Ave. The new facility will serve as headquarters for the company's Central Division, Inc., formerly located at 1652 East 87th St.

Lester Soliday is in charge.

For More Information Circle No. 53 on Reader Service Card.

Pictured — Semi-trailer mounted 2,000 gallon Cryotainer used to supply liquid to a cylinder charging system through a high pressure liquid oxygen pump.

Cryotainer®

STORAGE AND TRANSPORT CONTAINERS
CUSTOMER SERVICE STATIONS
FOR LIQUID OXYGEN, NITROGEN AND ARGON

Economy minded users of liquid oxygen, nitrogen and argon throughout the United States and Canada are turning to Cryotainers. *Profit conscious* gas distributors are installing Cryotainer customer service stations and enjoying the savings of compact, easily serviced, no-loss systems.
Whether stationary or on wheels, these efficient, low maintenance, national board stamped units can solve your cryogenic storage and handling problems.
Cryotainers are available in capacities of 50 to 2,500 gallons.

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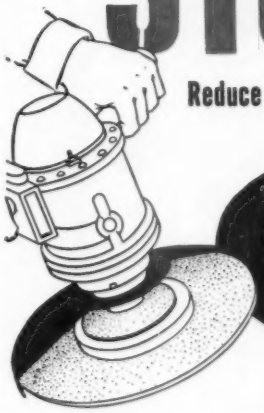
Reduce Insurance Costs • Cut Time Loss • Save Lives!



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STOP costly accidents with MORRISON Standard Wheel Guards! Safety codes and laws REQUIRE guard protection. Specify MORRISON for maximum safety . . . lighter weight . . . lower cost . . . greater strength. Full protection for operator with minimum interference with work.

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AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

Eliminates Spatter Grinding After Welding

YORK'S *SPAT-R-PRUF* COMPOUND 106

THREE *EASY* STEPS

1. Coat Surface
2. Weld
3. Wipe Off

A perfect paint base. No stirring or dilution necessary. No grinding after welding—spatter can be wiped away with a dry cloth.

IMPORTANT FEATURES

- Non Toxic
- Non Inflammable
- Pleasing Odor
- Harmless to Skin
- Helps Prevent Rust
- No Weld Porosity

Available in 1 gallon cans and 5 gallon cans and 55 gallon drums.

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STRUCTURAL WELDING

Continued from page 55

costs become excessive in order to accommodate his requirements.

I also suggest that whenever any inspection not normally contemplated by the Code—such as X-ray—is used, these requirements be set forth in detail in the job specification. These details should state the extent of such special inspection requirements and the standard of quality to be met so fabricators can realistically determine the additional costs involved because of this special inspection. It is the usual and proper practice that the costs of such inspections are paid by the owner. However, it may not be generally known that is only a part of the total costs for such special inspection. The slowing up of production processes and the additional handling of material are just two of the items of additional expense that must be borne by the fabricator.

FIELD ERECTION

The same high quality requirements of workmanship and inspection apply to field work. Of course some consideration must be given to the special requirements of field work. For example, it is most important that joints be designed for flat or downhand welding wherever possible. • •

New England Welding Conference Is Oct. 21-22

HARTFORD, CONN.: Current developments in welding will be the theme of the Fourth Annual New England Welding Conference to be held here on October 21 and 22, 1959.

The Conference is sponsored by the eight Sections that comprise District No. 1 of the American Welding Society.

A one day technical session at the Rockledge Country Club will be held on October 21. Concurrently a two day Welding Show will be held in the West Hartford Armory on October 21 and 22. Papers scheduled to be presented at the technical session are as follows:

"Electro-Slag Welding for Heavy Fabrication", "Welding of Chrome-Moly Piping", "Designing for Welding", "Welding by Electron Beams", "Economics in Designing and Manufacturing of Welded Fabrication", "Plasma Technology in the Welding Industry".

NEW PRODUCTS

Portable X-ray Equipment For Field Inspection

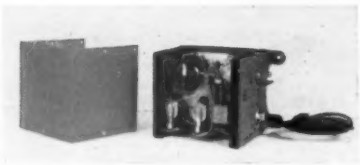
Field x-ray inspection of tanks, pipes and other structures is a simple operation with new portable equipment developed by General Electric's X-ray Department.

G.E.'s LX-140, which weighs only 46½ lbs., can now be used by field inspectors to radiograph the weldment at other than the construction site.

Control unit for the continuous 70 to 140 kvp range, weighs only 25 lbs. and is packaged in 26″ x 24″ x 18″ shockproof case. Simplified controls are said to enable the new operator to learn its operation with just a few minutes of instruction.

The new unit will produce radiographs with 2% sensitivity and 1.5 density with 1½ minute exposure through 1¼ inches of steel. It will operate in temperature from 0° to 120°F., humidity up to 95% and altitudes to 5000 ft.

For More Information Circle No. 104 on Reader Service Card.



Arc Welder Controller

A new, easy-to-attach electrical device introduced by Mor Welder Controller Co. gives the welding operator remote control of most gasoline driven-, motor generator- and rectifier-type welders. A single button on the electrode holder lets the operator start, stop and regulate heat from his welding position while welding is being done.

Circle No. 48 on Reader Service Card.

Tungsten Arc Torch

A new 200 ampere torch for manual inert-gas tungsten-arc welding is announced by the Linde Co., Division of Union Carbide Corporation.

It is said to be small enough to weld inside a 3-inch tube. The torch weighs 3.6 ounces and is 6⅞-inches long. It is equipped with small, flexible service lines that make the torch as easy to use as a pencil.

Circle No. 105 on Reader Service Card.

FACTS AT YOUR FINGERTIPS: *Do you want full information on the latest welding products shown on these pages? Just circle the appropriate number on the bound-in readers service card and you'll get it.*

STAINLESS STEEL welding scale & oxide go off with

OX-OFF

LIQUID CHEMICAL FORMULA 536

Costs far less than obsolete hand methods.

No more costly, time-wasting hand compounding, grinding and sanding. OX-OFF 536 acts *in seconds.* Just dip small stainless steel pieces in 140°F bath—OR stroke large pieces with electric applicator . . . welding scale and oxidation go fast and completely from surfaces and crevices.

ALUMINUM

Removes oxides from Aluminum by a mere wipe or dip.

Write for Tech Bulletin IW-G or see your welding distributor.

Chemclean Products Corp.
15-08 121 St., College Pt. 56, N. Y.

MANUFACTURERS OF INDUSTRIAL CHEMICALS AND SPECIALTIES

Circle No. 20 on Reader Service Card.

Lightweight Clothing

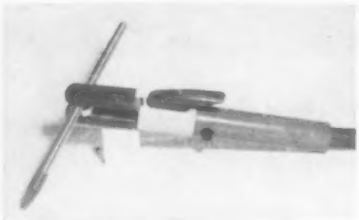
A new addition to their line of welding operator's protective clothing has been announced by the American Optical Co. The dark brown, soft leather garments which are lightweight and flexible are said to give excellent protection against welding heat. The line, a short jacket, a 26" jacket, sleeves, cape sleeves and 15½ oz. cape sleeve and bib (shown). All seams are cotton stitched and ends, rivet-reinforced. Anchor button at each armpit prevents cape from unbuttoning. Garments comes in five sizes.

Circle No. 106 on Reader Service Card.

Aluminum Filler Wire

A new aluminum filler wire (magnesium-aluminum) for use with the inert arc welding processes (tungsten and consumable) has been announced by Air Reduction Sales Co. Designated type A5556, the wire was developed for making high strength structural joints in high tensile 5083, 5086 and 5456 aluminum alloys, without need for subsequent heat treatment. The uniform, Type-A finish wire will be used on missile structures, ship superstructures, truck frames and diesel engine bases.

Circle No. 107 on Reader Service Card.



Metal Removal Torch

A new carbon arc-compressed air metal removal torch has been developed by the Arcair Co. Designed for heavy duty maintenance work, casting conditioning, plate edge preparation and weld backgouging, the H-5 features a convenient push button air control in its handle. Other features: moulded heat-resistant jaw insulators and silicone shielding of torch head against extreme heat.

Copper-plated carbon-graphite electrodes up to ⅝-inch diameter can be used with the H-5.

Circle No. 108 on Reader Service Card.

Welding Goggles

A new plastic eyecup is the principal feature of Sellstrom Manufacturing Co.'s improved welding goggles which also feature more efficient antifog ventilation.

The one-piece eyecup of the new Model No. 500 is said to be stronger and easily conforms to facial contours. The eyes are fully protected and extraneous light excluded. Designed for acetylene welding and cuting, the goggles are available with many different lenses and lens shades; Federal specification grades are available.

Circle No. 109 on Reader Service Card.

HI-AMP

ELECTRODE HOLDERS

CABLE ATTACHMENTS

GROUND CLAMPS

Offers

T.P.C.*

* THREADED POWER CONNECTION

Excessive heat in a welding circuit is oftentimes caused by a resistance build-up at some point in the welding circuit due to connections being loose or oxidization setting up in a mechanical type of terminal connection.

Shown in the above "cut-a-way" picture of an Eleo trode Holder is the new HI-AMP, T.P.C. type of connection that can be adapted to ground clamps and quick disconnect plugs as well as to electrode holders.

T.P.C. means a Threaded Power connection using the pressure of threads on a sleeve to drive the ends of any welding cable down into the depth of a cable socket, then locked into place with threaded plugs. An excellent electrical connection as well as providing direct contact with the welding cable to the accessory so that maximum heat is conducted into the heat-absorbing cable.

ASK YOUR WELDING SUPPLY HOUSE FOR FURTHER INFORMATION

354 W. ADAMS ST. LENCO, INC. JACKSON, MO.

For More Information Circle No. 39 on Reader Service Card.

Positioner Control

Designed to give the welding operator any travel speed for weldments of various diameters is the Auto Dial Control for P & H positioners, recently announced by Harnischfeger Corp. One dial sets for inches per minute, another, for weld diameter (to .01″). Both can be varied while weldment is in motion. In addition to full control of rotation and tilt, both forward and reverse, a Weld-Run switch gives full table rpm without disturbing weld settings. The system is integral with the electronic controller.

Circle No. 110 on Reader Service Card.

Ear Protectors

"Quiet-Ear" is a unique, new ear protector distributed exclusively by Bausch & Lomb Optical Co. It was developed by RCA to meet the need of personnel who work near loud noises.

The design of "Quiet-Ear" marks a new concept in ear protection. It uses no bulky absorbing materials, or large sealing shells. Where noise is a hindrance or nuisance, this lightweight, sanitary and inexpensive ear protector offers optimum noise protection.

Circle No. 111 on Reader Service Card.

Safety-Yellow Tester

The Amprobe Junior, a snap-around, volt-amp tester for checking both voltage and amperage to plus or minus 3% accuracy, now comes in safety yellow to conform to standard safety practices.

Manufactured by Amprobe Div., Pyramid Instrument Corp., the instant reading unit comes in 25, 50 or 100 amp full scale in either 125/250 or 150/600 volts.

Circle No. 112 on Reader Service Card.

Circle No. 48 on Reader Service Card.

NEW ARC WELDER CONTROLLER

with exclusive fingertip control

- **STARTS**
- **STOPS**
- **REGULATES HEAT**

at operator's position while welding is being done—a single button on the electrode holder controls this easy-to-attach electrical device

SAVES TIME, MONEY AND LABOR—MAKES FOR MORE ACCURATE WELDING

IDEAL for shipbuilding, boiler manufacturing, pipeline welding and construction work

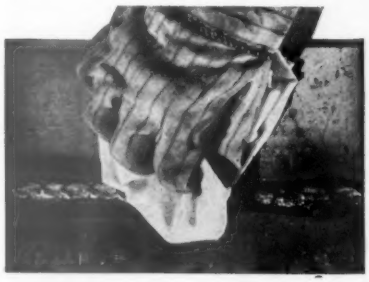
DESIGNED for use on most gasoline driven-, motor generator- and rectifier-type welders

Prices start at $149.50

Write for free data sheets

Mor Welder Controller COMPANY

417 Howard St., Lapeer, Mich.



cut weld cleaning time by 85%

THROW AWAY YOUR COLD CHISEL AND WHISK OFF WELD SPATTER WITH A DRY RAG! Protect-O-Metal spatter-proofing compounds make weld cleaning a breeze. Improve your welds at the same time . . . P-O-M compounds quiet the arc, improve oxidation and annealing scale, cause no porosity. No smoke, odors, or fumes.

P-O-M No. 2. Non-inflammable, non-toxic, water-soluble paste. Inorganic. Thin before applying and start welding at once. $3.40 per gallon, f.o.b. Dayton.

P-O-M No. 8. Rust- and corrosion-resistant resin base compound. Comes ready to use. Safe for all metals. Good paint primer; permits outdoor storage of sub-assemblies. $3.45 per gallon, f.o.b. Dayton.

Money-Back Trial Offer. Order a trial gallon of each today for testing in your shop. We'll cancel the bill if you're not satisfied.

Prevents Heat Treat Scale . . . up to 1500°F. Brush on, heat, brush off. All metals.

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For More Information Circle No. 58 on Reader Service Card.

the ARC-TWIN

Double Notches Pipe and Tubing with Each Downstroke of Punch Press!

PATENTED

SAVING both time and cost, it gives you perfect T-joints—instantly ready for welding or brazing without deformation or finishing! Twin-acting punch shears clean, from inside out, leaving two matching notches (in perfect 180° alignment) with every downstroke of the punch press. Quickly interchangeable dies and punches accommodate pipe and tubing from ½" to 2⅛" O.D.; special units, up to 3" O.D.

Special Arc-Twins for double notching stainless steel or monel metal and units built to your specifications can also be furnished.

Ask for twin-notched sample of pipe or tubing.

VOGEL TOOL AND DIE CORPORATION

1819 North 32nd Ave. • Stone Park, Ill.

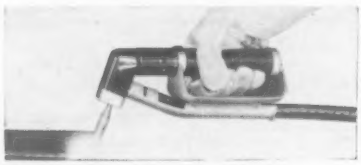
For More Information Circle No. 70 on Reader Service Card.

Rotating Head Saw

A new metal cutting circular saw featuring a head that is movable around its axis has been announced by the Wandsbeker Werkzeug Gesellschaft Beinhoff & Co., Ref. 78, Hamburg-Wandsbek Germany. Called the Barson-Rotor, the head of the new saw can quickly be swung 45 degrees to the left, 30 degrees to the right by releasing a guide screw. This is an advantage in making mitre cuts —the work does not have to be moved.

Capacity of the machine, equipped with an 11-inch diameter high speed steel saw blades, for round and square profile material is 3½" by 3½" or 1½" by 6"; for tubing, 3½" diameter; and for solid material, 2¼" diameter. A wheel-mounted cooling pump can be supplied for solid material cutting. Machine is available with an AC motor, a two-speed motor, or a single phase motor.

Circle No. 113 on Reader Service Card.



New 600-Amp Holder

A new electrode holder designed primarily to completely eliminate holder heating is announced by the Bernard Welding Equipment Co.

The operator's hand is kept cool in two ways. First, the cable is brought directly to within a fraction of an inch of the electrode and does not pass through the holder handle. The handle is empty, therefore there is no direct cable heat. Secondly, a lightweight aluminum hand guard protects the operator from heat radiated from the arc and work-piece.

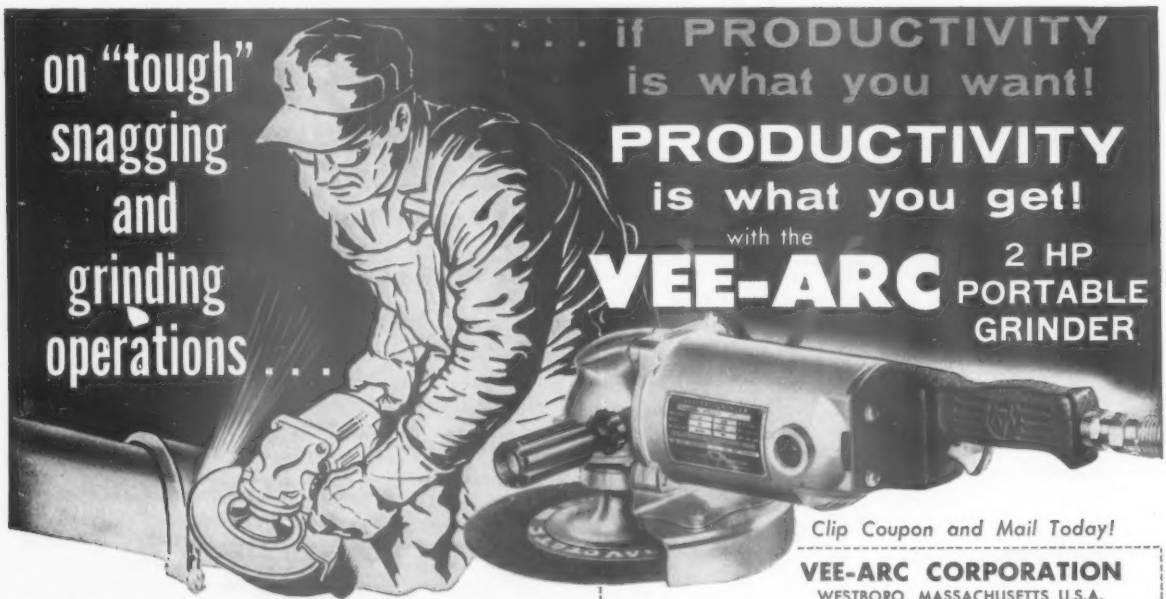
The Model 600 is 11 inches long and weighs only 28 ounces. It will handle electrodes from ⅛" through ⅜".

Circle No. 114 on Reader Service Card.

Automated Soldering

Faster, higher quality soldering of printed circuit boards or other electronic and machine component assemblies is now possible with the new FLOWSOLDER, an integrated soldering system manufactured by Electrovert, Inc. No manual operation is required between placing an assembled board on the conveyor and removing it after soldering. The system brings molten solder up to the under surface of the assembly rather than dipping the work into a static solder bath.

Circle No. 115 on Reader Service Card.


on "tough" snagging and grinding operations . . .
. . . if PRODUCTIVITY is what you want!
PRODUCTIVITY is what you get!
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2 HP PORTABLE GRINDER

This **NEW** powerful but light-weight grinder does **MORE WORK** with less operator fatigue . . . **DESIGN-ENGINEERED** for use with 9" disc wheels . . . can be plugged into nearest 120-v. AC power outlet . . . **LIFE-TIME LUBRICATED . . . TAMPER-PROOF SEALED . . . SIX MONTHS WARRANTY.** All this . . . and more for only **$168.00** f.o.b. nearest distributor.

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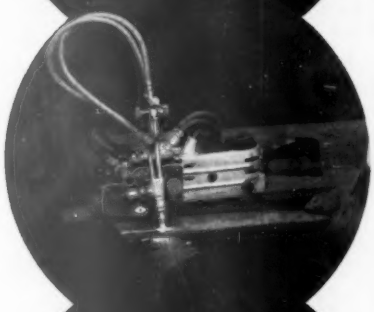
POWER . . . PRECISION . . . PERFORMANCE . . . PRODUCTIVITY

For More Information Circle No. 67 on Reader Service Card.

AT LAST!



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INEXPENSIVE • LIGHTWEIGHT
ECONOMICAL • VERSATILE

The Messer "Quicky" Pays for Itself!

Where can you use the new Messer "*Quicky*" cutting machine — now available in the United States for the first time.

The *Quicky* is perfect for cutting plate from ⅛ to 2½ inches. Yet it weighs ONLY 13 POUNDS!

You'll be amazed at the quality of this machine. Yet its low price means you'll get real savings when you use the versatile *Quicky*.

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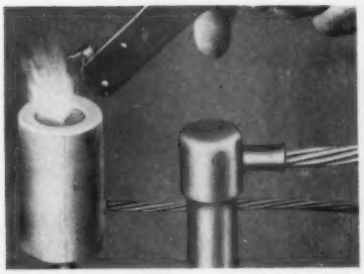
MESSER CUTTING MACHINES, INC.

WELDING ENGINEERING Messer SINCE 1898

CHRYSLER BLDG., 405 LEXINGTON AVE., N. Y. 17

Circle No. 44 on Reader Service Card.



Cable-Ground Rod Connection

Erico Products, Inc., has introduced an adaptation of their Cadweld Process (copper thermit) for making cable to ground rod connections. Called the One Shot Mold, the new product is a ceramic disposable unit which replaces the semipermanent graphite mold and handle clamp.

Besides the mold, the new mold package contains a powder cartridge, a metal disk, a wrap sleeve, and a ferruled sleeve—all that is needed to make a 100% current-carrying capacity connection that cannot loosen or corrode.

Circle No. 116 on Reader Service Card.

Oil Burning Salamander

A new oil burning salamander has been brought out by the Nugent Corporation. Features which add to its life and efficiency are: alloy cast iron elbow; rust-resistant galvanized bowl (24 ga.); two-piece stack; heavy diffusion hood and brackets; and accident-preventing lock down handles.

Circle No. 117 on Reader Service Card.

New Cable for Induction Heating Unit

A new flexible coaxial cable manufactured by the L. C. Miller Co., now permits the application of high frequency induction heating in inaccessible areas. The cable, is attached to an induction heater at one end and to a work coil at the other. Available in lengths from two to twenty feet. Excellent results have been obtained using two connected lengths forty feet from the heater.

Circle No. 118 on Reader Service Card.

PROTECT your acetylene cylinder investment!
Get all the facts about the

ALL NEW COYNE 92

(92% POROSITY FILLER)

ACETYLENE CYLINDER

NEW FORMULA FILLER
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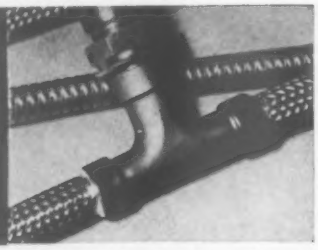
155 W. Bodley Ave., Memphis, Tenn.
3800 Springdale Ave., Glenview, Ill.
24 Commerce St., Newark, N. J.

Circle No. 22 on Reader Service Card.

For More Information Circle No. 4 on Reader Service Card.

SOLDERING PROBLEM?
stainless to aluminum?
aluminum to copper?
cast iron to steel?



BOEING 707 Landing Gear Harness
Braided stainless steel wire and flexible conduit had to be joined to cast fittings. Brazing burned the fine wire. ALL-STATE had a special solder which solved the problem. (See #430, below.)

You get high strength with ALL-STATE special solders

#7 Special solder for cast iron 450-600°F. Withstands 1000 psi P.

#37 Developed for joining aluminum with soldering iron at low 450°F. Good color match and corrosion resistance. Also joins dissimilar metals. 1000 psi P.

#39 Special solder to join all types of aluminum for both build-up (450°F) and capillary flow (650°F) – with or without flux. 8000 psi T.

#55 Newly developed aluminum "rubbon"® solder – NO FLUX – 705°F – 20,000 psi T. All aluminums.

#105 Special medium temperature alloy for both ferrous and non-ferrous metals (640-740°F) – to 25,000 psi T.

#107 The finest made to join aluminum to steel, copper and brass – or to each other (480-600°F) – to 25,000 psi T.

#430 NO LEAD, NO ZINC or CADMIUM – develops tensile strengths of 10,000 to 28,000 psi on stainless and dissimilar metals. For soldering iron at a low 430°F.

Send for ALL-STATE Instruction Manual. ®RUBBON is a registered trade name.

Distributor Stocked, convenient to buy. Economical to use.
ALL-STATE WELDING ALLOYS CO., INC., White Plains, N. Y.
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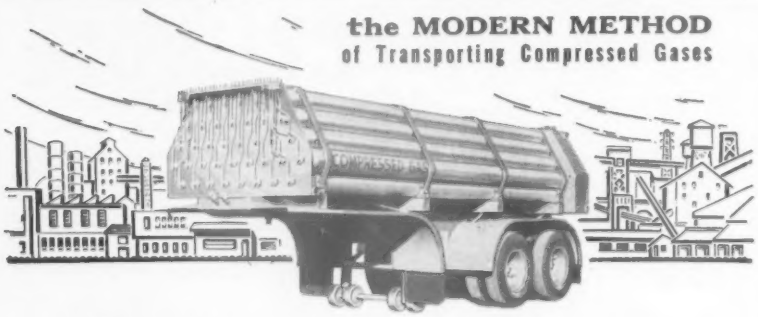
of Transporting Compressed Gases



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CYLINDERS AND GAS PRODUCING EQUIPMENT
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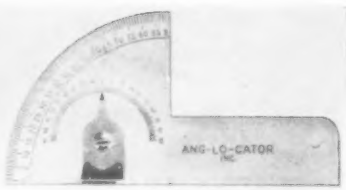
O'FALLON 2, ILLINOIS

For More Information Circle No. 36 on Reader Service Card.

New Gas Nozzles

Tec Torch Company, Inc., announces the introduction of a new and improved "Vycor" gas nozzle. The company reports: "Tests have proved the "Vycor" nozzles remain clear and transparent throughout welding applications and have been found to withstand temperatures up to 3200°F. These tests have also shown that increased gas coverage and a reduction of tungsten consumption have achieved unparalleled economies."

Circle No. 119 on Reader Service Card.



Ang-Lo-Cator Protractor

Ang-Lo-Cator, Inc., has appointed Contour Sales Corp. as the exclusive distributor of the Ang-Lo-Cator protractor, the all new and only measuring device for quickly and accurately determining the correct degree of angle on any pipe or structural material. This is said to eliminate the old fashioned "cut and try" method.

Circle No. 120 on Reader Service Card.

Mobile Gun Unit

A mobile gun unit developed by the Federal Machine and Welder Co. for general purpose spot welding features a light weight welded steel cart for easy moving. The welding transformer, heat regulator, electronic controls, air valve and flexible cables and air-operated gun are all mounted on the cart.

Circle No. 121 on Reader Service Card.

New Instrument Measures, Sorts Nonmagnetic Metals

A new portable transistorized eddy current instrument has recently been added to the group of testing systems available from Magnaflux Corporation. The battery-powered Magnatest FM-110 Conductivity Meter measures electrical conductivity and performs a variety of testing jobs; determines hardness, alloy and heat treat condition; sorts mixed nonmagnetic metals; checks tensile strength of aluminum; investigates fire damage to aircraft, and many others. This compact 3⅜" x 8¾" x 6½" instrument, weighing only 4½ pounds can be used for both production and on-site testing. Total range is 8% to 107% I.A.C.S., with an accuracy better than ±3% of scale reading, and usually better than ±1% when used on a comparative basis.

Circle No. 122 on Reader Service Card.

New Extruded Hard-Alloy Wear Strip Rectangles

Twenty-three new sizes of extruded rectangles are being produced by Ampco Metal, Inc. to supplement the firm's line of wear strip and wear plate material.

The new rectangles are extruded Ampco metal grade 21, a hard alloy recommended for severe metal-to-metal wear applications, extremely heavy loads and abnormally high abrasive conditions. Ampco metal grade 21 extruded rectangles appeal to the automotive, machine tool and allied industries, large users of gibs, slides, wear plates and ways.

Average physical properties of the extruded rectangles are: 110,000 psi. ultimate tensile strength: 68,000 psi. yield strength; 50,000 psi. elastic limit in compression and 310 Brinell hardness (3,000 kg. load).

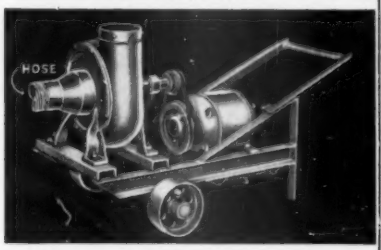
Circle No. 123 on Reader Service Card.

Circle No. 54 on Reader Service Card.

RUEMELIN *Portable*

Fume Collector

Removes gas, smoke and heat from welding operations. Recommended for ventilation of tank interiors, manholes, vats, airplane fuselages or for blowing fresh air into inaccessible places.



• Collector is equipped with a power unit capable of handling up to 35 ft. of steel tubing. Mounted on rubber tired wheels for ease of handling. Models also available mounted on steel legs for hose operation in a complete 360 degree circle.

• This view shows inlet hood picking up welding smoke. Operator breathing zone protected.

WRITE FOR DETAILED INFORMATION.

RUEMELIN MFG. CO.

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Manufacturers and Engineers • Sand Blast and Dust Collecting Equipment • Welding Fume Collectors

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1936

THE NEWEST PORTABLE SPOT WELDER

Merit Might Midget

Completely new . . . and engineered for today's production demands . . . the Merit Might Midget is the perfect answer to all your welding problems.

- Trouble-free electronic timer and contactor
- Welds up to 3/16" combined thickness
- Uses standard #1 Morse taper tips
- Variable tip pressure—0 to 1000 lbs. in seconds
- Available in 2 models; Water-cooled or Air-cooled

For additional information, ask your jobber or write: The Merit Company, 2124 W. Chicago Ave., Chicago 22, Ill.

Sold through jobbers only
Contact:

SPOT WELDER DIVISION

THE MERIT COMPANY
2124 W. Chicago Avenue
Chicago 22, Illinois

For More Information Circle No. 43 on Reader Service Card.

For More Information Circle No. 29 on Reader Service Card.

Flood FIBER GLASS WELDING HELMETS
For Safety, Comfort and Economy

These seamless fiber glass units (of thermo-setting, polyester resin) are compression-molded and stoutly reinforced to afford maximum protection. All are fitted with the new Fit-Rite, snap on, ratchet type headgear—the most comfortable, durable and easiest-to-maintain you can buy, and not more expensive.

NEW DESIGN ADVANTAGES

1. Lighter weight for more comfort.
2. A smoother and stronger shell.
3. Easier cleaning and sterilizing.
4. Non-warping moisture-proof construction.
5. Superior resistance to heat.

No. 51-br-2H

No. 53-8F-2H

No. 51-2F-2H

Enjoy real savings with Flood's
1000-HOUR COVER LENS
Outlasts 125 glass lenses. Reduces eye fatigue. Safer because shatter-proof.

No. 53-2F-2H

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11%-13½% MANGANESE-NICKEL STEEL
WEDGE BARS
Available in 23 sizes.
Cost less than new teeth.

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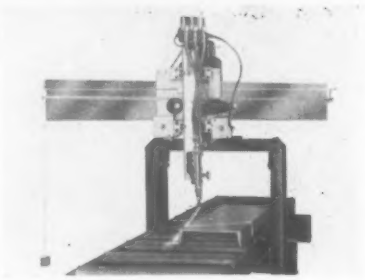
WRITE FOR COMPLETE DETAILS AND NEAREST DISTRIBUTOR

For More Information Circle No. 61 on Reader Service Card.



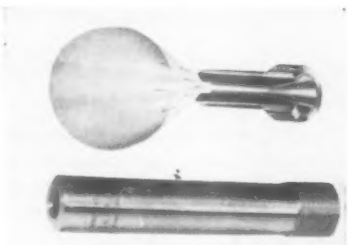
Structural Shape Cutter

The structural shape cutter manufactured by Steffan Manufacturing Corp. is said to greatly reduce handling, layout and cutting time on structural shapes such as I-beans, H-beams, angles, channels, bars, and plates. Two independently operated variable-speed motors activate the horizontal and vertical geared tracks, insuring a smooth, steady cut.

Constant heat is achieved by solenoid valves which coordinate the gas and oxygen at the burning tip. An adjustable dial can be set to allow smooth, mitered or straight cuts.

Structural shapes are handled easily on roller conveyor. Cutters are available in 24-, 36-, and 48-inch sizes.

Circle No. 124 on Reader Service Card.

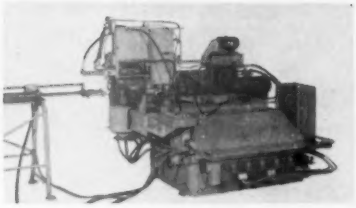


Blast Cleaning Nozzles

A new "Norbide"-lined venturi-style nozzle with long blast cleaning life is announced by Clementina Ltd.

These venturi-style nozzles are available in sizes ranging from 3/16" to ½" diameter orifices. All are threaded with straight pipe threads and are jacketed in shock-resistant steel tubing. Nozzles are designed for use with all types of blast cleaning equipment, and can be used with silicon carbide, aluminum oxide, and all other abrasives.

Circle No. 125 on Reader Service Card.



Tube Bending Machine

A high production tube bending machine has been announced by The Wallace Supplies Mfg. Co. The bender positions, bends, and removes the tubing automatically—two per cycle. Only the supply must be kept coming. Simple tooling changes give a variety of bends: 1800 flat-back U's can be made an hour; 980 return bends every hour.

An elevator stands tubes up in two loading trays; sorting fingers load trays automatically when tubes get down to two. Hydraulic cylinders index tubes into bending dies and supporting mandrel's slip into tube ends. A stripper unloads and drops tubes onto a conveyor.

Circle No. 126 on Reader Service Card.

New Pocket Tape Holster

"Holster-Pak", a new concept in packaging and point-of purchase merchandising, has been introduced by Evans Rule Company.

All Evans steel pocket tapes (except thin-tape) now come packaged in Holster-Pak, a sturdy leather-like fitted holster that clips to the belt.

Circle No. 127 on Reader Service Card.

Brazing Flux

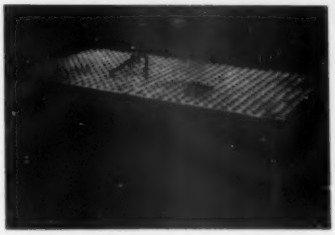
A new flux for induction and short cycle brazing has been developed by the American Silver Co.

Wonderflux #4 has unusual characteristics: the lowest surface tension; melting point (480°F) hundreds of degrees below the brazing alloy's; and water-thinness at 800°F. The flux is said to cover every part of the joint well in advance of alloy flow. This protects against oxide island formation. The brazing temperature flux fluidity is eased off by the brazing alloy without trapping flux. Non-corrosive, non-hygroscopic and non-effervescent, the flux comes in 1- and 5-lb sizes.

Circle No. 128 on Reader Service Card.

Circle No. 80 on Reader Service Card.

WELDING AND SET-UP PLATENS



MADE IN VARIOUS SIZES TO SUIT YOUR PARTICULAR JOB

Speed-X welding and assembly platens are available in the following sizes: 5' x 5', 6' x 6', 3' x 6', 4' x 8', 3' x 8', 6' x 8', 4' x 4', 6' x 10', 6' x 12'. Precision fabrication to close tolerances requires a perfectly level dogging table for layout, assembly and welding. Speed-X blocks are adaptable to hold down bolts as well as goose neck dogs so they do the work of both bending blocks and T-slot tables. Only Speed-X offers this truly unusual table. A complete line of accessories, including dogs—hold-down bolts—pins, U-clamps, and prefabricated tables also available.

STAHL EQUIPMENT CO.

94 Washington St.
Brookline Village 46, Mass.

Circle No. 15 on Reader Service Card.

BATEMAN BANTAM IRON WORKER

THE ONLY IRON WORKER OF ITS KIND ON THE MARKET TODAY

No Grinding Necessary After Cut. One Stroke Cycle Clutch Operated by Hand or Foot.

The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

Bateman Bantam with punch....$575.00
Shear only $495.00
Shipping wt. 750 lbs.

BATEMAN FOUNDRY & MACHINE
MINERAL WELLS, TEXAS

THERMO is FIRST Again with a Revolutionary Sta-Kleen All-Plastic Cover Lens

Never Before Available for Use in Welder's Helmets

40% MORE LIFE

LABORATORY TESTS PROVE WHY . . .

- ✓ TWICE as Scratch Resistant as any other All-Plastic Lens on the market.
- ✓ 40% MORE Resistance to Molten Slag

Make your own test and PROVE to yourself that THERMO Sta-Kleen All-Plastic are the cheapest and safest Cover Lens you can wear.

See Your Welding Supply Dealer
or
write for a FREE Sample TODAY

THERMACOTE Company
108 S. DeLacey Ave., Pasadena, Calif.

For More Information Circle No. 62 on Reader Service Card.

Automatic Pipe Welder

A new machine said to weld aluminum pipe faster, better and less expensively than ever before has been announced by Aluminum Company of America. The machine employs the consumable electrode process to make sound, full-penetration welds without backup rings on 4- to 11-inch diameter tubular products. Welding head can be angled many ways or be set to oscillate to insure filling.

Features of the new pipe welder include: magnetic amplifiers and semi-conductors (replacing electronic tubes) and locker, vapor-proof cabinets that house electrical controls.

Circle No. 129 on Reader Service Card.

New Ultrasonic Flaw Detector

A brand new ultrasonic test instrument, the Sonoray Model 5, has been announced by Branson Instruments, Inc.

Designed with the user in mind, the new instrument offers simplified operation, convenient size and weight for field testing, yet preserves the flexibility required for laboratory requirements. The bright oscilloscope trace is visible under normal shop lighting conditions.

An optional plug-in flaw alarm, weighing only two pounds, will activate bells, relays, or other devices to signal that allowable test limits have been exceeded.

The instrument operates on 110-v, 60-cycle current, and draws 160 watt. The instrument weighs 35 pounds, and measures 11 x 7⅝ x 20¼ in deep.

Circle No. 130 on Reader Service Card.

Sorting Instrument

A transistorized conductivity-permeability meter which rapidly sorts mixed lots of metal parts has been announced by Metrol, Inc. The Heatcheck instrument tests ferrous and non-ferrous metals for heat treatment, relative hardness and strength, purity and decarb.

A hand-held probe's electro-magnetic field excites eddy currents in the test parts—in three seconds. Measurements are made on any flat (⅝" diameter) surface—rough, dirty, or paint-covered. Conditions above and below preset are indicated on meter and by alarm lights.

Circle No. 131 on Reader Service Card.

COMING EVENTS

September 24-25: Central Zone Meeting, National Welding Supply Association, Statler-Hilton Hotel, Detroit.

September 28-29: Eastern Zone Meeting, N.W.S.A., Hotel Roosevelt, New York City.

October 11-16: Pacific Area National Meeting, American Society for Testing, Sheraton-Palace, San Francisco.

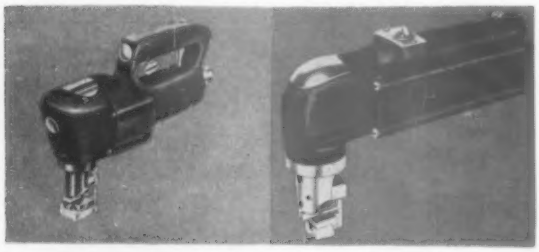
October 19-20: West Central Zone Meeting N.W.S.A., Pick-Nicollet Hotel, Minneapolis.

October 22-23: Western Zone Meeting, N.W.S.A., Riviera Hotel, Las Vegas, Nevada.

November 30-December 1: Southeastern Zone Meeting, N.W.S.A., Atlanta Biltmore Hotel, Atlanta.

December 3-4: Southwestern Zone Meeting, N.W.S.A., Hotel Texas, Fort Worth.

April 25-29: 41st Annual Meeting and Welding Exposition, American Welding Society, Los Angeles.



Model HN Model LN

CUT YOUR METAL CUTTING COSTS 75%, USE THE FENWAY POWERFUL, PORTABLE NIBBLER WITH THE BIG PUNCH

INCREASE PRODUCTION! Save Metal Waste! Eliminate Finishing Operations!

Portable FENWAY NIBBLERS (air powered or electric) are easily moved to the cutting job (wt: 8-13 pounds according to model)—You can cut up to five feet per minute without distortion. Your metal waste is cut to a minimum—No grinding or buffing to finish off. Fenway Nibblers cut up to 8 gauge mild steel or 10 gauge stainless. Easily converted to cut corrugated sheeting, small diameter ducts, formed sheet metal pipe, tough pitch or asbestos coated corrugated steel—consistent smooth edges, no curling, no chipping, no flaking. Investigate this powerful, durable time saving nibbler. Easy to handle, minimum maintenance, unconditionally guaranteed.

WRITE TODAY FOR FREE DEMONSTRATION

FENWAY MACHINE CO., INC.,

3107 N. Broad St., Phila. 32, Pa.

For More Information Circle No. 28 on Reader Service Card.

Flow-Mang

WELDING ELECTRODES

NEW FLOW-MANG

NEW FLOW-MANG

13% Manganese and 3% Nickel—was scientifically developed to answer the demand for welding electrodes which can be used even on difficult out-of-position welding jobs. Flow-Mang can also be used for welding high manganese steel to a low or high carbon steel.

THERE'S NO TIME LAG—WITH FLOW-MANG

Flow-Mang is easy to work with. There's no lost time or special training required. Flow-Mang does your work for you —whether you're running a vertical, horizontal, down or overhead bead.

WELDERS GET THE JOB DONE FASTER

'cause there's no peening or puddling with Flow-Mang. This low hydrogen type coating can be welded in a stringer bead or a puddle bead.

FORD STEEL CO.

5051 Pattison

St. Louis 10, Mo.

MANGALLOY FOR BUILD-UP AND STELLITING

For More Information Circle No. 30 on Reader Service Card.

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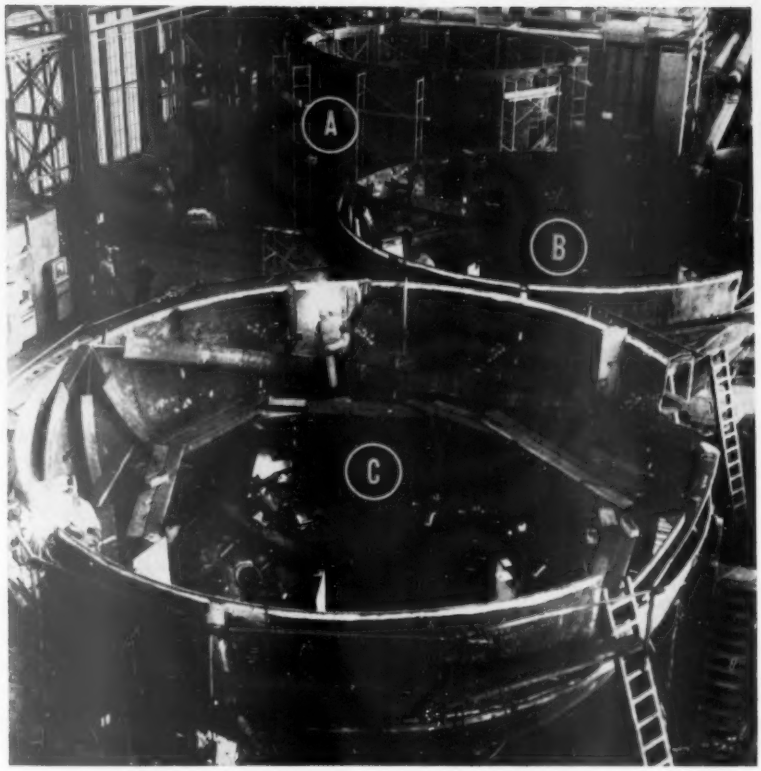


WELDING OPERATORS fabricate 250-ton steel shell. They . . .

Use low hydrogen electrodes on nuclear ship's containment vessel

CAMDEN, NEW JERSEY: The giant 250-ton steel shell which houses the entire reactor plant and primary cooling system for the N. S. Savannah, the world's first nuclear-powered merchant ship, was fabricated here at the New York Shipbuilding Corp.

The containment vessel consists of a center cylindrical section (A) 35-feet in diameter, 16-feet long and from 2⅜- to 3¾-inch thick. The ends are two hemispheres (B and C) 1¼-inches thick. The sheel steel is SA-212, Grade B.

The two hemispherical heads and the center section were fabricated separately, as shown here, using Type E7016 low hydrogen, all-position electrodes.

Preheating was done before welding. Root passes were inspected by the magnetic particle method. After welding was completed, all butt and seam welds were radiographed completely. All fillets were inspected by magnetic particle.

Each section was then stress relieved and assembled in place on the ship. Following assembly, the entire containment vessel was tested at 173 psi.

The Murex electrodes used in fabricating this containment vessel were supplied by Metal & Thermit Corp.

Whitehead Opens Syracuse Office

SYRACUSE, NEW YORK: A new sales office and warehouse covering a total area of 45,000 square feet has been opened here by Whitehead Metals, Inc. Located in Syracuse Industrial Park, the new building has 40,000 square feet of warehouse area and 5,000 of office space.

Circle No. 21 on Reader Service Card.

Get the exact current for quality welding!

USE THE TONG-TEST AC-DC AMMETER

Don't assume your welders are using the right amperage. *Be certain* by controlling welding quality with the Columbia Tong Test AC-DC Ammeter, the only clamp-type instrument that measures both alternating and direct current. Snap tongs around the electrode cable for instant readings. Available in five types with interchangeable ranges up to 1000 amperes. Impossible to read wrong scale. No coils or wires to burn out—no electrical connections needed.

COLUMBIA

Write for Illustrated 8-page Catalog IW-400

Columbia Electric Mfg. Co.

4545 Hamilton Avenue • Cleveland 14, Ohio

Is Jet Rod Causing Your Present Holder To Overheat?

Duro's New Durogon Heavy Duty is the answer. Heavy Bronze Construction with replaceable jaw plates, it is the holder you should be using for this type of welding.

Lots of 1-11 .....$7.15 each
Lots of 12-49 ..... 6.45 each
Lots of 50-149 .... 5.65 each

Send your order today for a sample for trial and name of your nearest distributor.

Send for free literature on the complete line of Duro Holders.

The DURO Engineering Company

31 OREGON AVE. HAMDEN, CONN.

Circle No. 25 on Reader Service Card.

Airline Welding Builds New Plant

LOS ANGELES: Groundbreaking ceremonies for a new $150,000 facility for Airline Welding and Engineering were celebrated here recently by more than 100 employees and officers at the company's new site, 159th and San Pedro streets.

Byron H. Russell, Airline president, turned the first spadeful of earth for the new 38,000 square foot "tilt-up" concrete building which will be completed about October 1st.

The company was formerly located in Hawthorne, Calif.

Select Jury For Lincoln Design Awards

CLEVELAND, OHIO: Dr. E. E. Dreese, chairman of the James F. Lincoln Arc Welding Foundation has announced the members for the jury of award to select the award designs in the Foundation's $50,000 Machine Design Award Program which closed July 20.

The following men met in Alanson, Michigan, in August to select the award designs best illustrating the application of the advantages of welded steel design to machinery of all types: Frank Gleve, Assistant Chief Engineer, United Engineering and Foundry Company, Pittsburgh, Pennsylvania; A. R. Holowenko, Professor of Mechanical Engineering, Purdue University; LaFayette, Indiana; Gordon M. Sommer, Vice President of Engineering, Clearing Machine Company, Chicago, Illinois.

The 54 awards to be made will be announced early in the fall.

Alloy Rods Opens Warehouse In Oakland

OAKLAND, CALIFORNIA: Alloy Rods Company has established a warehouse here at 95 Market Street to service Oakland-San Francisco-Bay area. A sales office had been maintained in the area for the past three years with shipments being made from the company's plant at El Segundo.

NEW OXYGEN STORAGE and distribution installation is inspected at Earle M. Jorgensen Company's San Francisco steel warehouse by P. C. Childs (left), vice president, and W. W. Fenstermacher, manager. The Linde unit consists of a vacuum-insulated tank which stores the gaseous equivalent of 25,000 cubic feet of oxygen in liquid form at 300° below zero. It replaces the bank of cylinders shown and is the first installation of its kind for industrial applications in San Francisco.

THE NEW WAY TO CUT WELDS

ZEPHYR WELD SHAVER

Zephyr's Weld Shaver cuts and finishes medium weld beads in one operation. One pass of this lightweight tool mills flat, concave and convex weldments to within 0.001" flushness. Invaluable in plants which require precision weld finishing. Two tested models available: ZT508 for stainless steel and other hard alloys; ZT509 for aluminum and other soft alloys. Carbide and steel cutters sold separately. *Ask for catalog.*

Producers of Precision Tools
ZEPHYR MANUFACTURING COMPANY, Inc.
201 Hindry Ave., Inglewood, Calif.

Circle No. 79 on Reader Service Card.

PORTABLE SANDBLAST GUN Complete: simply connect to air line

RUGGED—EFFICIENT

$27.50 (including one spare jet and 2 spare nozzles)

FOR THE LAB OR SHOP

A complete inexpensive sand blast unit for cleaning before and after welding. For sand blasting metal surfaces or small parts. Order one today. It pays for itself quickly.

LINDBERG PRODUCTS CO.
P.O. BOX 908W LAKEPORT, CALIF.

Circle No. 41 on Reader Service Card.

WE HAVE THE FLUX RIGHT For Your Job

62 years of experience in scientific development in welding

Whatever the particular job you have to do—we have the right FLUXINE you need. Besides our 25 FLUXINES we carry a complete line of "KOP-R-ARC" coated rods for welding copper and all copper alloys.

Write on company letterhead for chart and generous sample stating which FLUXINE desired.

KREMBS & COMPANY
(Est. 1875)
Dept. K, 669 W. Ohio St., Chicago 10, Ill.

Circle No. 38 on Reader Service Card.

CLASSIFIED

"Positions Wanted": $8.00 minimum, limit 25 words. For all other classifications: $10.00 minimum for 25 words; each additional word: 25c. Boldface type or all caps: $12.00 minimum for 25 words; each additional word 35c. Box address counts as five words. All insertions payable in advance.

DISTRIBUTORS WANTED

Lowest Costs—Highest Profits
Fully Guaranteed Materials
Meets all Gov't, AWS, ASTM Specifications.

Low Fuming Bronze Rod—Aluminum—Nickel Silver—Silver Solder—Flux—Phos Sil 0,2,6,15 Alloys

Write today for full details

AMERICAN BRAZING ALLOYS CO.
P. O. Box 11 Pelham, N. Y.

General Dynamics Takes Over Hench Gas Business

CHICAGO, ILLINOIS: General Dynamics Corporation has acquired the industrial and medical gas business of the Hench associated gas enterprises, it was announced by Rex L. Nicholson, president of the Liquid Carbonic Division of General Dynamics Corporation.

The activities of the Hench gas enterprises cover most of the eastern seaboard from Maine to Florida and extend inland to Ohio. Principal products are oxygen, acetylene, argon, nitrogen nitrous oxide, hydrogen and welding equipment.

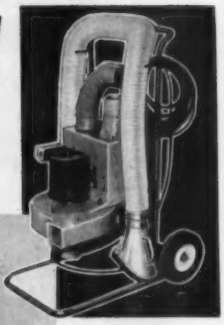
In all, General Dynamics is acquiring 17 gas producing plants, including two hydrogen plants, an acetylene plant and an oxygen plant in New England; a hydrogen plant, two gaseous oxygen plants, a liquid oxygen, nitrogen and argon plant, an acetylene plant and a nitrous oxide plant located in the New York metropolitan area; two oxygen plants and an acetylene plant in Pennsylvania; an oxygen and an acetylene plant in Ohio; and an oxygen and an acetylene plant in Florida.

The leading Hench organizations and their principal areas of activity are: New England Gas Products, Inc., Boston, Mass.; American Oxygen Service Corporation, Harrison, N. J.; Commercial Gas Corporation, Wilkes-Barre, Pa.; Buckeye Oxygen Corporation, Canton, Ohio; and Florida Gas & Chemical Corp., Dania, Florida.

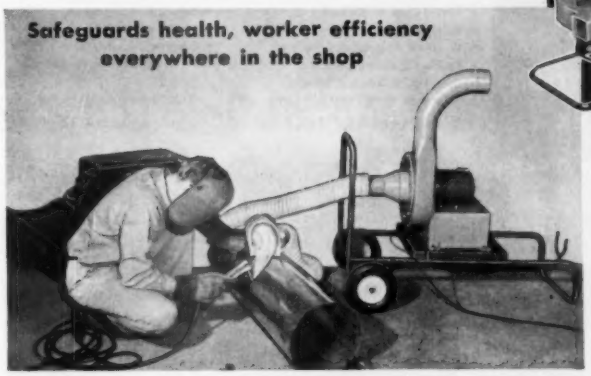
For More Information Circle No. 19 on Reader Service Card.

Now you can Weld Safely Anywhere!

***New* CAR-MON Portable Exhauster**



Safeguards health, worker efficiency everywhere in the shop



COMPACT
Takes up only 5 sq. ft. in upright position.

New Car-Mon Portable Exhauster rids the air of gases, fumes, smoke. Rolls anywhere — lets you utilize the whole shop for welding, soldering or brazing operations. Saves valuable time, money, and effort. Up to 24 feet of tubing can be attached to fan discharge to expel fumes away from operator or out of the building.

WRITE FOR CATALOG

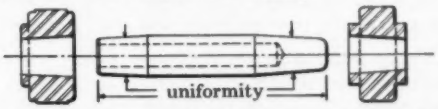
CAR-MON PRODUCTS, Inc. 1541 W. Devon Ave. Chicago 26, Ill.

TUFFALOY

They Look different... and they Are!

The bright and shiny look of the new Tuffaloy spotwelding tips is due to a process that practically eliminates oxidation. More than that, it reflects the deep-down quality built into these tips and into all Tuffaloy products.

What you want in these tips is highest conductivity and resistance to deformation. Tuffaloy provides this by the most modern manufacturing methods, and by constant scientific quality control all the way: alloying of pure copper, semi-continuous billet casting, bar extrusion and salt bath heat treating.



And in converting this high-quality bar stock to welding tips, Tuffaloy insures conformity to all standard dimensions. Before shipment all tips must pass inspection by gage for uniformity in length, Morse taper, and the outline of the point.

Tuffaloy resistance welding alloy products are widely available through Airco and Tuffaloy representatives. Call on them for SPOTWELDING TIPS (Standard, 'Tuffcap', Cold-Bent, and Special), Holders and Adapters, BAR STOCK, FORGINGS, SEAM WELDING WHEELS, and all other welding alloy needs. Ask for Catalog and Price List.

AIRCO

AIR REDUCTION SALES COMPANY
A Division of Air Reduction Co., Inc.
150 East 42nd Street, New York 17, N.Y.

For More Information Circle No. 64 on Reader Service Card.

For More Information Circle No. 68 on Reader Service Card.

HOW TO SAVE TIME and MONEY ON YOUR PIPE FABRICATION WORK

Put this "one-man pipe shop" to work in your plant

Produces straight or beveled cut-offs, saddle and insert type tee intersections, lateral intersections and miters. Extremely simple to operate. Pipe is laid on rollers. The horizontal reciprocating movement of the cutting torch is automatically guided and synchronized with the rotation of the pipe to produce the contour of the cut desired. Used by oil refineries, constructors, pipe fabricators, aircraft companies, tank manufacturers, etc.

SOME OUTSTANDING PANTOGRAPH FEATURES and ADVANTAGES

- Handles any length pipe.
- No chucking required.
- No layout or templates required.
- No hand trimming—cuts are smoothly finished and beveled.
- Makes uniform cuts on production runs.
- Two models available—Model C (shown)—handles pipe from 2" to 24" diam. Model G for pipe up to 42" O.D.

WRITE FOR BULLETIN NO. P-10

VERNON TOOL CO., LTD., 1101 MERIDIAN AVE., ALHAMBRA, CALIFORNIA

VERNON "PIPE-CUTTING" PANTOGRAPH

BECKER Keen-Cut Electrodes for use in

CARBON ARC-AIR JET GOUGING

KEEN-CUTS—for the best characteristics of carbon and graphite in a carbon arc cutting electrode. Higher current capacity ... longer life ... shorter cutting time ... greater material removal ... smooth surface gouge ... controllable accuracy ... hot stable cutting arc ... elimination of smoke and gases.

And they're low in cost. Try BECKER KEEN-CUT ELECTRODES—black or copper coated, standard diameters, 12" lengths in 150 to 1400 amp. range—for the most efficient, labor-saving electrode in carbon arc/compressed air cutting.

A COMPLETE LINE OF CARBON AND GRAPHITE WELDING SUPPLIES—carbon and graphite electrodes, carbon rods and plates, welding paste, graphite cores and chills, graphite powder and particles of any mesh.

Write for Catalog

BECKER BROTHERS CARBON CO.

3442 South Laramie Ave. • Cicero 50, Illinois

Telephone: BI 2-1260 • Chicago

Circle No. 18 on Reader Service Card.

No Other Product Can Do a Galvanizing Job Like *Galvalloy* Does - *HERE'S PROOF*

Heat welded seam on galvanized sheet to 600° with Torch

Rub GALVALLOY against heated surface as shown — now spread with wire brush for a bright finish.

GALVALLOY Covers the Same Amount of Area with 1/5 the Amount of Material.

Send today for Testing Sample and you'll learn Why GALVALLOY has no equal for ANY Galvanizing Job.

METALLOY PRODUCTS CO.

1233 S. BOYLE AVE., LOS ANGELES 23

Circle No. 45 on Reader Service Card.

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WELDING CLINIC

J. Imperati and R. F. Pulver, Welding Engineers
The American Brass Company, Waterbury, Conn.

EVERDUR® ROD SPEEDS WELDING OF GALVANIZED STEEL

Arc welding is usually the most expedient means of reducing distortion, the major source of trouble in welding light-gage metal. However, metal-arc welding with covered electrodes adds more problems than it solves, due to difficult control and the need to remove slag and spatter from the product. Such difficulties are frequently encountered in steel sheet metal work.

In contrast, carbon-arc and inert-gas tungsten-arc welding offer easy control and eliminate slag and spatter. When these processes are used with a copper-alloy filler rod, such as Everdur-1010, control is greatly improved because Everdur's lower melting point produces bonding with only minimum melting of the steel. Increased welding speeds and the narrow heat-affected zones mean reduced distortion. Joint properties are adequate for all but the most exacting applications.

The narrow heat-affected zones make these processes attractive also for welding galvanized steel because they cause the least possible disruption of the protective zinc coating. With non-rusting copper-alloy welding rods they make the most dependable joints possible. So, Everdur-1010 has become a favorite filler metal for use with these processes in the fabrication of galvanized structural elements, ducts, and various types of container.

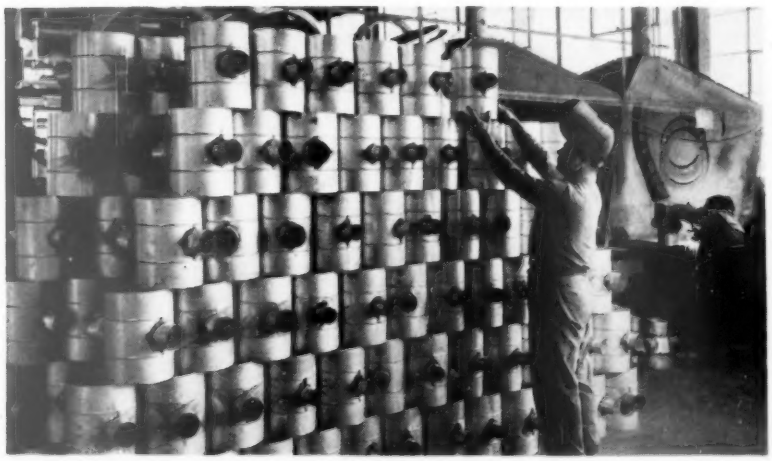
WELDING AIR-CONDITIONING DUCT SYSTEM FITTINGS at Carrier Corporation's plant in Philadelphia, using the carbon-arc process, with Everdur-1010 Welding Rod.

Carrier Corporation is one of the many concerns that utilize these advantages in their manufacturing operations. For many years, fittings and other components of their air-conditioning duct systems have been produced with ease and economy by welding with the carbon arc and Everdur-1010 Welding Rod.

Best results in welding either plain or galvanized steel require that only the least possible amount of steel be melted. To insure this it is necessary to avoid weaving so as to keep the arc always on the bronze weld metal. Arc lengths are kept as short as possible and current values set low enough to require welding speeds that can be handled with ease.

Joint types usually employed in sheet metal work—square butt, lapped, edge, and corner welds—are suitable for use with these processes.

Free Technical Service. If you have questions regarding the possible application of these processes to your job, Anaconda specialists will gladly help with suggestions. For such help or a copy of Publication B-13 write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.



ANOTHER VIEW OF AREA devoted to welding Carrier duct system components.

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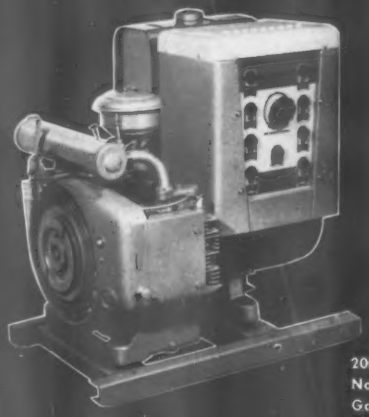

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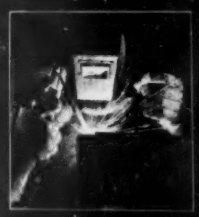

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